No.

Government of Nepal
Ministry of Local Development

JAPAN INTERNATIONAL
COOPERATION AGENCY

THE STUDY
ON
THE SOLID WASTE MANAGEMENT
FOR THE KATHMANDU VALLEY
(Monitoring and Follow-up Phase)

FINAL REPORT

VOLUME I: EXECUTIVE SUMMARY

March 2007

NIPPON KOEI CO., LTD.

YACHIYO ENGINEERING CO., LTD.

G E
J R
07-026

Government of Nepal
Ministry of Local Development

JAPAN INTERNATIONAL
COOPERATION AGENCY

THE STUDY
ON
THE SOLID WASTE MANAGEMENT
FOR THE KATHMANDU VALLEY
(Monitoring and Follow-up Phase)

FINAL REPORT

VOLUME I: EXECUTIVE SUMMARY

March 2007

NIPPON KOEI CO., LTD.

YACHIYO ENGINEERING CO., LTD.

LIST OF VOLUMES

- Exchange Rate; Rs 1 = USD 0.0148 = JPY 1.776

USD 1 = JPY 119.78

As of March, 2007

- Fiscal Year; July 16 –July 15

Shrawanta to Ashadha (Nepalese)

PREFACE

In response to a request from the Government of Kingdom of Nepal, the Government of Japan decided to conduct a study on “The Study on Solid Waste Management for the Kathmandu Valley” and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr.Toshiyuki UJIIE of NIHON KOEI Co., LTD. and consisted of experts from NIHON KOEI Co., LTD. and YACHIYO ENGINEERING Co., LTD. between January 2004 and July 2005. The study team conducted field surveys at the study area and held discussions with the officials concerned of the Government of Kingdom of Nepal. In September 2005, the final report was completed.

From November 2005, JICA started the Monitoring and Follow up phase of the project and dispatched the study team again in order to promote implementation of the proposed plan in the final report. This report binds up the activities and achievements during the Monitoring Follow up phase.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Kingdom of Nepal for their close cooperation extended to the study.

March 2007

Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency

March 2007

Mr. Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

Dear Sir,

We are pleased to submit herewith the final report of the Monitoring and Follow-up for "The Study on Solid Waste Management for the Kathmandu Valley".

In the Kathmandu Valley in Nepal, the amount of solid waste generated is increasing and the living environment in the region has been steadily deteriorating because the capability of the municipalities concerned has not kept up with the increased demands of solid waste management. In order to tackle these problems, the study team together with the Nepalese counterparts conducted a series of filed surveys including the pilot projects implementation between January 2004 and July 2005. The final report of the Study containing the action plans on solid waste management, which were formulated by each of the five municipalities in the Kathmandu Valley, namely Kathmandu Metropolitan City, Lalitpur Sub-Metropolitan City, Bhaktapur Municipality, Madhyapur Thimi Municipality and Kirtipur Municipality, toward 2015, was submitted in September 2005.

From November 2005, the monitoring and follow-up of the action plans have been conducted. In the monitoring, the Nepalese counterparts together with the study team checked implementation status of the activities in the annual work plans which were prepared based on the action plans. For the follow-up, the study team supported environmental and social considerations on facility development such as a long-term landfill site, and provided technical training and recommendations such as for operation of short-term landfill site.

Although implementation of the action plans has just started, the activities in the action plans are expected to be continued and extended by the Nepalese counterparts themselves.

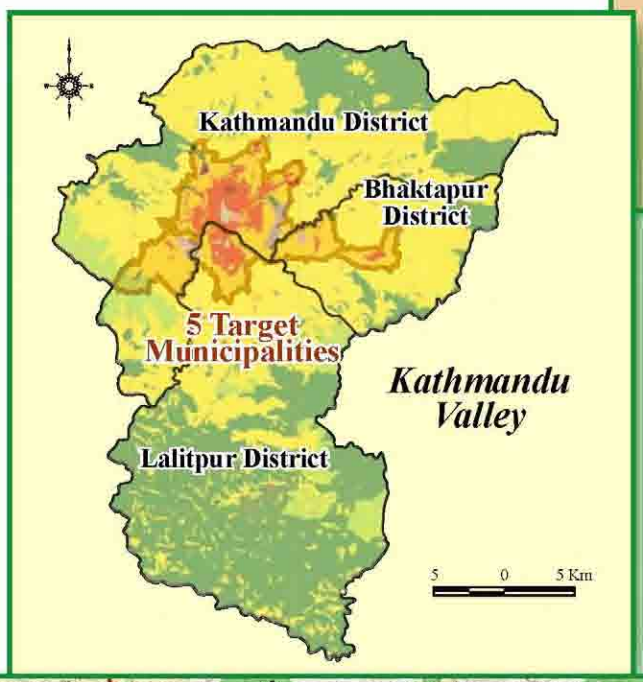
We wish to express our sincere appreciation to the officials of JICA, the JICA Advisory Committee, the Ministry of Foreign Affairs, the Ministry of Environment, the Embassy of Japan for Nepal, and JICA Nepal Office for their continuous support throughout the Study including the Monitoring and Follow-up. Also, we would like to express our great appreciation to Government of Nepal, especially the members of the Steering Committee, Technical Working Group, Task Forces, and NGOs/CBOs concerned for their active participation in the Study.

Finally, we hope that the outputs of the Study as well as the Monitoring and Follow-up will contribute greatly to improve solid waste management in the five municipalities of the Kathmandu Valley and to foster a long lasting partnership and friendship between the two nations of Japan and Nepal.

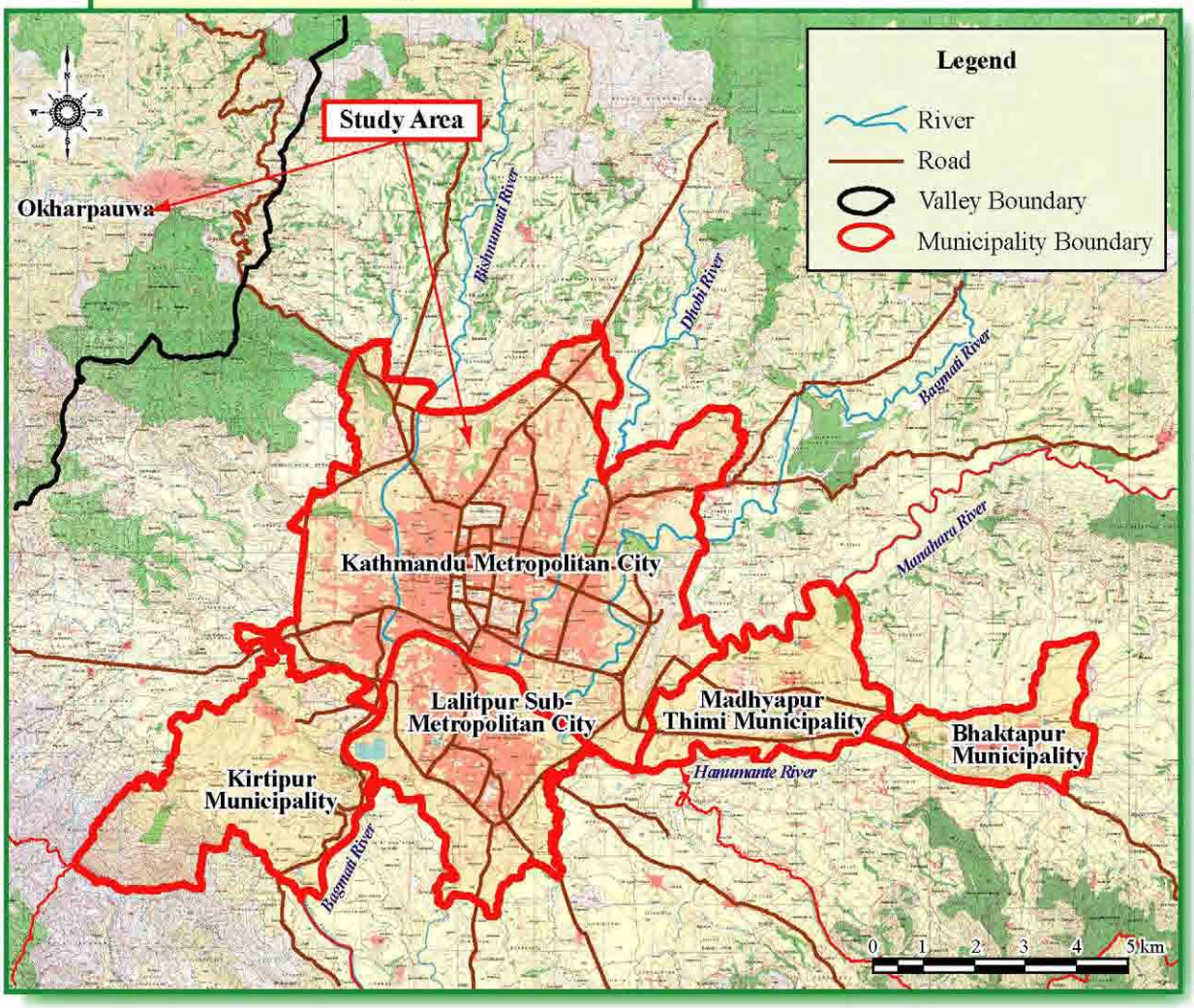
Yours faithfully,

Toshiyuki UJIIE
Leader for JICA Study Team


China
Nepal
India
Kathmandu Valley


Kathmandu District
Bhaktapur District
5 Target Municipalities
Kathmandu Valley
Lalitpur District
5 0 5 Km

Study Area


Legend
River
Road
Valley Boundary
Municipality Boundary
Study Area
Okharpauwa
Bishnumati River
Dhobi River
Bagmati River
Manahara River
Kathmandu Metropolitan City
Lalitpur Sub-Metropolitan City
Madhyapur Thimi Municipality
Bhaktapur Municipality
Hanumante River
Kirtipur Municipality
Bagmati River
0 1 2 3 4 5km

SUMMARY OF MONITORING AND FOLLOW-UP OF THE STUDY

1. Background of the Study

Solid waste management (SWM) in the Kathmandu Valley faces great challenges not only in relation to the management system but also in gaining public awareness and participation of the people. In order to improve the situation, the Government of Nepal and the Government of Japan undertook a joint study titled "The Study on the Solid Waste Management for the Kathmandu Valley (the Study)" with the technical assistance of the Japan International Cooperation Agency (JICA). The Study commenced in January 2004 and ran for a total of 20 months until August 2005.

In the course of the Study, Action Plans (A/Ps) were prepared on solid waste management (SWM) for five municipalities in the Kathmandu Valley, namely Kathmandu Metropolitan City (KMC), Lalitpur Sub-Metropolitan City (LSMC), Bhaktapur Municipality (BKM), Madhyapur Thimi Municipality (MTM), and Kirtipur Municipality (KRM), and technology transfer regarding SWM for the Nepalese counterpart personnel was carried out.

In the Monitoring and Follow-up phase of the Study, the progress of implementation of A/Ps was monitored and follow-up technical assistance provided to sustain activities targeted in the Study.

2 Objectives of the Monitoring and Follow-up

The Monitoring and Follow-up was basically carried out to achieve the following outputs:

1) Improvement in the capability of solid waste management based on implementing the AWP of each municipality and SWMRMC.
2) Improvement in the capacity regarding formulation of sustainable solid waste management system through the smooth operation of the transfer station and landfill site.

3 Monitoring of Action Plan Implementation

Monitoring sessions were carried out three times by the Task Force together with the JICA Study Team. The major items monitored were the actual implementation situation and budget execution after the commencement of this fiscal year. Each session was also open to municipal staff outside the Task Force, and the results have been fed back to the five municipalities and the SWMRMC.

- First Monitoring Sessions
  (Monitoring including support for finalization of the AWPs) : November, 2005
- Second Monitoring Sessions
  (Mid-term Monitoring and Evaluation) : February, 2006
- Third Monitoring Sessions (Final Monitoring and Evaluation) : July or August, 2006

In the 1st monitoring session, AWPs were thoroughly reviewed and some necessary changes of the plans were made as per the actual municipal situation such as viability of budget and other external circumstances. It was observed, in the 3rd session, that staff in charge has high morale and enthusiasm to carry out the scheduled activities although the progress of some activities has been affected by the unavoidable circumstances of Nepal.

Finally, activities of the respective AWPs for the fiscal year of 2006/2007 (2063/64) were prepared by each Task Force through a series of AWP development sessions.

4 Follow-up for Action Plan Implementation

(1) Collection and Transportation in BKM and MTM

As the source separation activity in BKM has been continued and operated well, preparation has been made to apply this activity to other core areas. As for waste collection and transportation practice in MTM, it was reported that collection time was unstable, and that waste was not collected in holidays, which were recognized as points to be improved and tackled.

(2) Waste Minimization Activities

KMC has operated the medium-scale vermi-composting plant established in the Teku transfer station (T/S) premises since March 2005. The Community Recycling Center (CRC) has been also run by KMC at Ward-21 to buy and store recyclable materials as well as selling cut flowers and vermi-compost, etc. The following were recommended for ensuring the sustainability of medium-scale vermi-composting plant operation;

- Supplies of vegetable waste for the plant by KMC should be secured.
- Labor conditions should be improved, for example salary of staffs/workers should depend on amount of compost produced to increase motivation. It is recommended that the vermi-composting plant should be managed by a suitable NGO or private agency.
- Continuing effort is required to develop a market for the product and in public relations to enhance the marketing of vermi-compost.
- The use of animal excrement should be considered to improve the quality of the composting product.
- The vermi-composting plant should be utilized as a training center for composting.

After the Study, KMC, LSMC and KRM have been continuing home composting activities at their own expense. The following are recommended for this activity:

- Municipality should subsidize home compost bins as appropriate as possible so that residents can acquire one easily in cheaper price but can motivate composting operation by sharing a certain amount of bin cost. Other options such as utilization of water tanks as home compost bins should be considered and promoted to residents.
- Municipality should arrange places/opportunities, like the CRC, for those who want to sell the compost product for earning money. Since the result of the market survey revealed that there is a potential for use of compost by farmers in and around the valley, municipality should also monitor and encourage the sales market of the compost products continuously.
- Sharing of information, not only on home composting but also on waste minimization activities should be made periodically through CoMoN meetings.

In KRM, the activity of plastic separation has been implemented and extended. Since it was observed that employment of a motivator was effective for maintaining momentum on the activity, continued employment of a motivator was recommended for the monitoring and follow-up of the activity.

(3) Solid Waste Data Management

Follow-up workshops for data management were held twice and participants at the workshops concluded that the database should be further improved because establishment of a reliable database system is essential.

The management situation of database and the present skill of operators were assessed, and sample formats for the generation of annual reports based on the available data of LSMC and MTM were developed.

5 Follow-up for Environmental and Social Considerations for Facility Development

(1) Follow-up for EIA on Banchare Danda Long-term Landfill Site

1) Basic Considerations for the Concept Design

The basic considerations for the concept design of Bancahre Danda Long-term Landfill Site were set as follows:

- For the sanitary landfill the semi-aerobic type will be applied.
- The horizontal liner will be applied along the site bed and to a height of around 5 meters along the slopes.
- In order to estimate the leachate quantity, the average of rainfall data from both stations of Kakani and Dhunibeshi has been used.
- Leachate treatment will be by aeration and sedimentation ponds with re-circulation, and the ponds will have sufficient capacity so as not to discharge of the leachate to the adjacent river.
- The waste storage dams will be constructed by the soil-cement method.
- Passive venting of the landfill gas will be adopted.
- The access road under design by the SWMRMC should lead into the administration area proposed to be constructed on the western area of the site
- It was decided that the river diversion channel should pass the saddle point of the central plateau. A chute channel was selected as the most appropriate type for the river diversion scheme.
- The expected life span is between 19 and 20 years because the volume available for waste disposal was estimated as 3.96 million m^3.
- In order to reduce leachate production the area will be divided into four (4) sections.

2) Facilities Plan with Phased Development

The landfill will be developed in two phases. In Phase 1, there are two stages, and the waste disposal operations will start upon completion of Phase 1 - Stage 1. It was estimated

that a total 20 months would be spent for development of the site including the rainy season when construction work might be affected by weather conditions.

Overall costs of the site were estimated at Rs 2.6 billion in total over the period of 32 years.

Cost Component		Million Rs	Remarks
1) Development		1,677.5	Phase-1 and Phase -2
2) Procurement of Equipment	Initial	106.4	Procurement in FY 2009/10
	Renewal	143.2	Procurement for replacement afterwards
	Total	249.6	
3) O&M		613.6	Total of 20 years from 2009/10 until 2028/29
4) Post-closure Maintenance		47.6	Total of 10 years from 2029/30 until 2038/39
Total		**2,588.3**	

Source: JICA Study Team

(2) Follow-up Survey for Other Facility Development

In the case of development of the permanent transfer stations, screening to determine the level of environmental assessment (EIA or IEE) should be conducted based on the scale and activities of each project. As the areas of both the Balaju T/S and the Afadole Temporary T/S are less than 3 ha, IEEs including environmental management and monitoring programs should be conducted. The IEEs need to be approved by the relevant authority, namely Ministry of Local Development.

6 Follow-up for Secondary Transportation and Sisdol Short-term Landfill Operation

(1) Follow-up for Secondary Transportation

The following were recommended for secondary transportation based on operational practice in Teku T/S during the follow-up activities:

- It is suggested that KMC need to find the most appropriate way to receive waste from the split level platform without over-spill and to consider ground markings so the drivers can gauge their positioning when stopping secondary transportation vehicles.
- The frequent changes of waste management policies from day-time to night-time, again to day-time collections and increased waste pickers' activities have affected the operation of Teku T/S. It is recommended that KMC should prepare an operation plan together with consideration of the fundamental waste collection and transportation policy and plan. KMC should also have meetings to let local residents around Teku T/S for the preparation of the operation plan.

(2) Follow-up for the Operation of Sisdol Short-term Landfill

The following were recommended to improve the current operation of Sisdol short-term landfill (Sisdol S/T-LF) through the follow-up activities:

- Blocked vertical vents should be repaired by excavating surrounding waste and tires installed. The vertical vents should be extended using gabion nets and surrounded by boulders. The boulders placed should be, at minimum, 1.0 m diameter.

- The operator should continue to improve the site internal access to ensure that the waste collection trucks can unload the waste near to the waste disposal area.
- In addition to the road developed at the commencement of the waste disposal, service roads should be developed periodically to ease the access of the waste collection trucks to the site.
- The silt in leachate pond should be removed periodically. The aerator in the leachate pond should be operated for at least six hours daily.
- The leachate, groundwater and river should be sampled and tested, as a minimum, on a bi-monthly basis.
- For the completed landfill areas, the final cover should be applied and drains should be made to divert the rainwater from penetrating to the waste layers.
- The site manager needs to spend more time at the landfill in order to make operation more efficient and to learn as much as possible from the site experience. Operation records, waste arrival records and visitors logs should be maintained continuously.

7 Recommendations

Although the unstable political situation of Nepal has much influenced the progress of scheduled activities in the AWPs for the fiscal year 2005/2006 (2062/2063), the following were recommended, as a result of lessons learned from the first year's experience, for further action plan implementation to be tackled independently by the SWMRMC and the five municipalities:

- As it may take time to enroot the annual work cycle consisting of planning – budgeting – implementation – evaluation in each of the five municipalities, it is recommended that the monitoring system should be practiced in the municipality as an official process.
- Considering the current changing situation of Nepal, amendments of the A/Ps based on the situation as well as progress of the scheduled activities may be necessary.

The JICA Study Team also recommended the following based on the follow-up and monitoring activities:

- As current full-scale transportation may be more than 100% operation capacity, efforts should be made continuously to develop additional transfer stations and a waste processing facility to minimize waste to be transported as well as to procure additional secondary transfer vehicles.
- During May to July 2006 when all the waste was transported to Sisdol S/T-LF and Bagmati dump site was closed, the number of waste pickers at Teku T/S almost doubled. Thus, the appropriate number of waste pickers that can work at Teku T/S, without hindering the operations and endangering their own safety, should be considered and those allowable should be registered. It is also necessary to consider options for the remaining waste pickers.
- The SWMRMC and KMC should continue to make effort to solve the issues related to site selection as well as others for implementation of the development of a waste

minimization facility. An authorized working group, which has been organized in the last fiscal year, should be functioning soon.

- The SWMRMC should advance EIA procedure to develop the Banchare Danda landfill and immediately start preparation and construction of the access road to the site. Also, the SWMRMC should carefully consider its capacity to cope with all the activities related to implementing this large project.
- The Sisdol S/T-LF will be completely filled by January 2008. On the other hand, Banchare Danda long-term landfill is expected to be ready to receive the waste by July 2009. It is therefore necessary to consider what measures need to be taken for landfilling during this period. One alternative that could be considered is to use the Aletar land, which was purchased by the SWMRMC, for a temporary landfill.
- BKM and MTM involve more of their general communities in discussions on establishing the landfill site and not only hold discussions with communities where the proposed site is located. The SWMRMC should play a larger role in this matter, as they are the government agency responsible for development of sanitary landfill within the valley.
- Nature is kind to Kathmandu Valley as witnessed by the quick growth of green areas around the Bagmati River dumpsite. However problems of methane gas generation as well as leachate still prevail. In the absence of effective safe closure, people should be warned of the dangers of tapping onto unpurified methane gas, building upon old dumpsites and playing in the river near these areas.

VOLUME I: EXECUTIVE SUMMARY

Table of Contents

List of Figures

List of Tables

Abbreviations

<Organizations>

BKM	Bhaktapur Municipality
CDS	Community Development Section
CDSS	Community Development and Sanitation Section
CEN	Clean Energy Nepal
CMU	Community Mobilization Unit
DOMG	Department of Mines and Geology
ENPHO	Environment and Public Health Organization
G/N	Government of Nepal
GTZ	German Technical Cooperation Agency
JICA	Japan International Cooperation Agency
KMC	Kathmandu Metropolitan City
KRM	Kirtipur Municipality
LSMC	Lalitpur Sub-Metropolitan City
MOAC	Ministry of Agriculture and Cooperative
MOEST	Ministry of Environment, Science and Technology
MOES	Ministry of Education and Sports
MOHP	Ministry of Health and Population
MOICS	Ministry of Industry, Commerce and Supplies
MOLD	Ministry of Local Development
MOPE	Ministry of Population and Environment
MOPPW	Ministry of Physical Planning and Works
MTM	Madhyapur Thimi Municipality
NPC	National Planning Commission
OSLSMCC	Okharpauwa Sanitary Landfill Site Main Coordination Committee
ST/C	Steering Committee
SWMS	Solid Waste Management Section (KMC)
SWMRMC	Solid Waste Management and Resource Mobilization Center
T/F	Task Force
TWG	Technical Working Group
WEPCO	Women Environment Preservation Committee

<Metric Units>

g	Gram
g/L	Gram per liter
ha	Hectare
kg	Kilogram
kg/day	Kilogram per day
kg/d-capita	Kilogram per day per capita
km	Kilometre
km^2	Square Kilometer
L	Liter
mm	Millimeter
m^2	Square Meter
m^3	Cubic Meter
mg/L	Milligram per liter
m	Meter
ton/day	Ton per day
ton/year	Ton per year

%	Percentage

<Currency>

JPY	Japanese Yen
Rs	Nepalese Rupee
US$	US Dollar

<Others>

A/P	Action Plan
AWP	Annual Work Plan
BOD	Biochemical Oxygen Demand
CBO	Community Based Organization
CEO	Chief Executive Officer
CKV	Clean Kathmandu Valley
COD	Chemical Oxygen Demand
CoMoN	Community Mobilization Network
C/P	Counterpart
CRC	Community Recycling Center
DADO	District Agriculture Development Office
DfA/P	Draft Action Plan
DF/R	Draft Final Report
EIA	Environmental Impact Assessment
F/R	Final Report
FY	Fiscal Year
GIS	Geographic Information System
GRDP	Gross Regional Domestic Product
HCB	Home Compost Bin
HCI	Health Care Institution
HH	Household
HRD	Human Resource Development
IC/R	Inception Report
IEC	Information, Education and Communication
IEE	Initial Environmental Examination
IT/R	Interim Report
KVMP	Kathmandu Valley Mapping Project
LF	Landfill
LFS	Landfill site
L/T	Long-term
M&E	Management and Evaluation
M/M	Minutes of Meeting
MTEF	Medium Term Expenditure Framework
NGO	Non Governmental Organization
ODA	Official Development Assistance
OEP	Overall Equipment Plan
OFP	Overall Facility Plan
OJT	on-the-job training
Off-JT	off-the job trainings
O&M	Operation and Maintenance
PPP	Public Private Partnership
S/T	Short-term
S/T-LF	Short-term Landfill

STV	Secondary Transportation Vehicle
SWM	Solid Waste Management
T/S	Transfer Station
UGR	Unit Generation Rate
VDC	Village Development Committee
WPF	Waste Processing Facility
3R	Reduce, Reuse, Recycle

CHAPTER 1 INTRODUCTION

1.1 Background of the Monitoring and Follow-up

1.1.1 The Study on Solid Waste Management for the Kathmandu Valley

Solid waste management (SWM) in the Kathmandu Valley faces great challenges not only in relation to the management system but also in gaining public awareness and participation of the people. In order to improve the current situation, the Government of Nepal (GON) and the Government of Japan undertook a joint study titled "The Study on the Solid Waste Management for the Kathmandu Valley (the Study)" with the technical assistance of the Japan International Cooperation Agency (JICA). The Study commenced in January 2004 (Magh 2060[1]) and ran for a total of 20 months until August 2005 (Bhadra 2062). The final report of the Study was submitted to the Nepalese side in September 2005.

The Study was conducted with the following objectives;

1) To formulate Action Plans (A/Ps) on SWM for five municipalities in the Kathmandu Valley, namely Kathmandu Metropolitan City (KMC), Lalitpur Sub-Metropolitan City (LSMC), Bhaktapur Municipality (BKM), Madhyapur Thimi Municipality (MTM), Kirtipur Municipality (KRM), and Solid Waste Management and Resource Mobilization Center (SWMRMC), and
2) To pursue technology transfer regarding SWM for Nepalese counterpart (C/P) personnel.

In particular, capacity development of the Nepalese C/P personnel for planning and management of solid waste was carried out over the study period, which included the implementation of a series of pilot projects (P/Ps) as well as activities regarding public awareness raising.

1.1.2 Monitoring and Follow-up of the Study

In the course of the Study, A/Ps on SWM towards the target year of 2015, consisting of vision, approach, strategies and necessary activities, were developed by respective five municipalities and SWMRMC.

In order to gear up for appropriate and steady implementation of the activities stipulated in the respective A/Ps by the Nepalese side, the Monitoring and Follow-up of the Study (the Monitoring and Follow-up) was conducted from November 2005 to March 2007 with the following main two components;

1) Monitoring of A/P Implementation (the Monitoring): to check the implementation progress of the activities stipulated in Annual Work Plans (AWPs), and provide

[1] Nepalese Year

recommendations for steady implementation of the activities and for development of next fiscal year's AWPs

2) Follow-up: for A/P Implementation (the Follow-up): to provide technical assistances to implement the activities stipulated in AWPs including social and environmental considerations on development of proposed facilities and operation of secondary transportation and Sisdol short-term landfill (S/T-LF).

As the results of the Monitoring and Follow-up, recommendations for further implementation of the A/Ps were also provided by the JICA Study Team.

1.2 Objectives of the Monitoring and Follow-up

The Monitoring and Follow-up was basically carried out to achieve the following outputs:

1) Improvement in the capability of solid waste management based on implementing the AWP of each municipality and SWMRMC.
2) Improvement in The capacity regarding formulation of sustainable solid waste management system through the smooth operation of the transfer station and landfill site.

1.3 Target Activities

The target activities for the Monitoring and Follow-up were the activities stipulated in the respective Annual Work Plans (AWPs) of the five municipalities and the SWMRMC for the fiscal year 2005/2006.

1.4 Organization and Staffing of the Monitoring and Follow-up

The Study established three implementation organizations on the Nepalese side, which are the Steering Committee (ST/C), Technical Working Group (TWG) and Task Force (T/F). These implementation organizations of the Study were continuously active during the Monitoring and Follow-up.

1.5 Work Flow of the Monitoring and Follow-up

The Monitoring and Follow-up includes works in Japan as well as works in Nepal that have been implemented since November 2005 as Phase 4. The overall workflow of the Monitoring and Follow-up is shown in Figure 1.5-1.

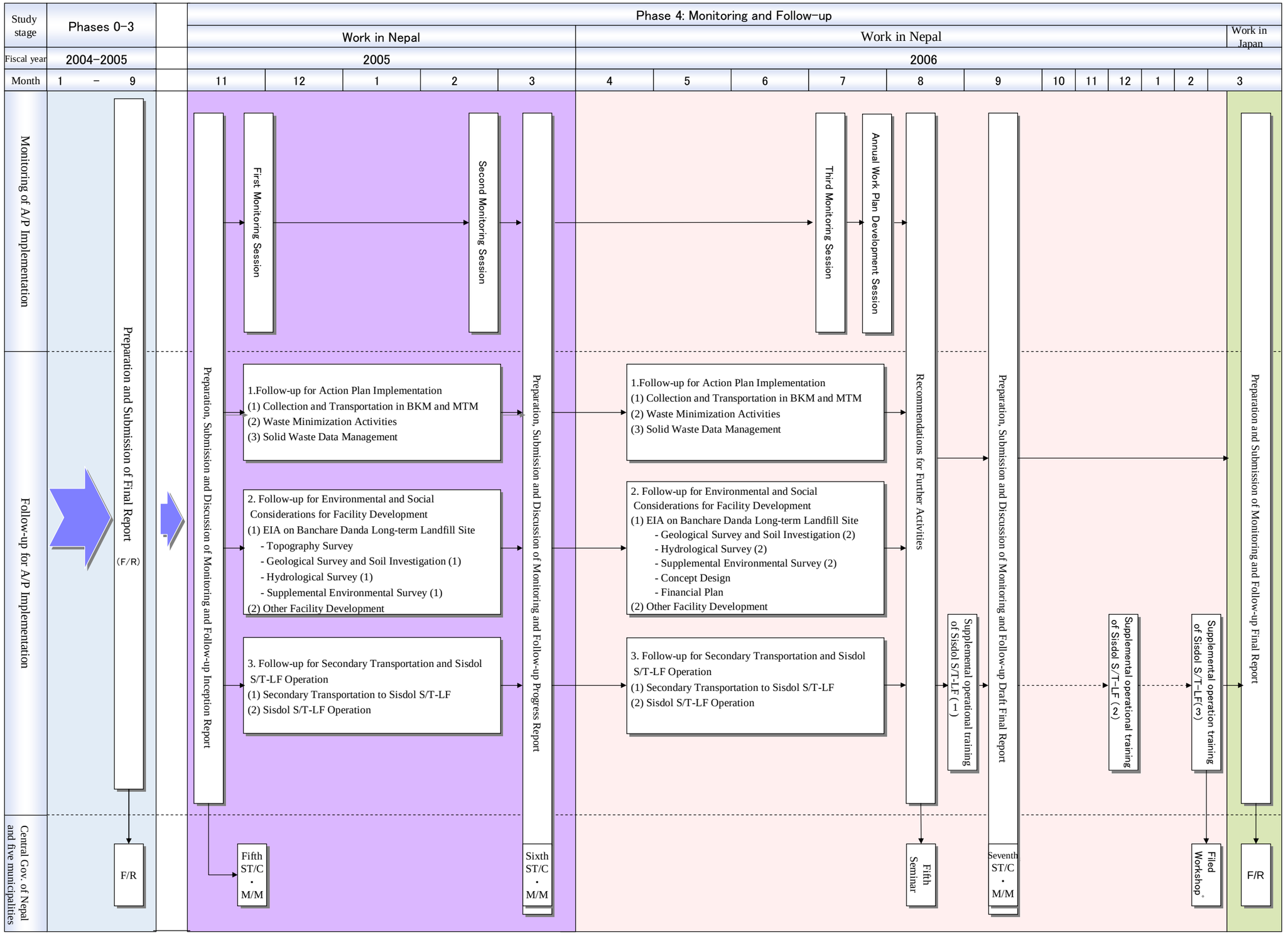


Figure 1.5-1 Overall Work Flow of the Monitoring and Follow-up

CHAPTER 2 MONITORING OF ACTION PLAN IMPLEMENTATION

2.1 Overall Monitoring System of Action Plans

The A/P is a long-term strategic plan to be implemented starting fiscal year 2005/2006 (2062/63) to 2014/15 (2071/2072). In order to ensure that the A/P is implemented in an effective and sustainable manner, a mid- and long-term monitoring system needs to be put in place to bind together both individual and collective achievements of the SWMRMC and the five municipalities. Such system should be installed both at the municipal level, as well as the valley level, in line with the institutional arrangements.

In principle, monitoring of A/P implementation should be conducted at two levels. The first level of monitoring of the A/Ps should be conducted at the benchmarked years of 2008 and 2011, which are the final fiscal years within short- and mid-terms, respectively. This end of term monitoring is recommended to holistically review the A/Ps implementation from the perspectives such as relevance, effectiveness, efficiency, impact and sustainability of municipal activities. The solid waste management ratio should be calculated at individual municipalities, to assess the progress of SWM activities as indicated in the targets of the respective A/Ps. In 2015, the final evaluation should be also conducted to examine whether the ultimate target of 93% solid waste management ratio is achieved, and to draw best practices and lessons learned for future SWM programs.

The second level of monitoring of the A/Ps should be conducted when each municipality and SWMRMC formulates their respective AWPs, which in fact are a breakdown of activities as identified for short-, med- and long-terms. The monitoring exercises in this level are mainly to check the progress of the activities of the AWPs as well as budget allocation and execution. During the monitoring exercise, necessary measures can be considered if there is any constraint to implement the activities. Based on the result of this level monitoring, together with influences from external factors, the contents of next fiscal year's AWPs should be developed.

The overall monitoring system of A/P is as illustrated in Figure 2.2-1. This system should allow enough flexibility so that the activities stipulated in the A/Ps can be changed, dropped or added insofar as the overall effect on the SWM program would be to increase the solid waste management ratio.

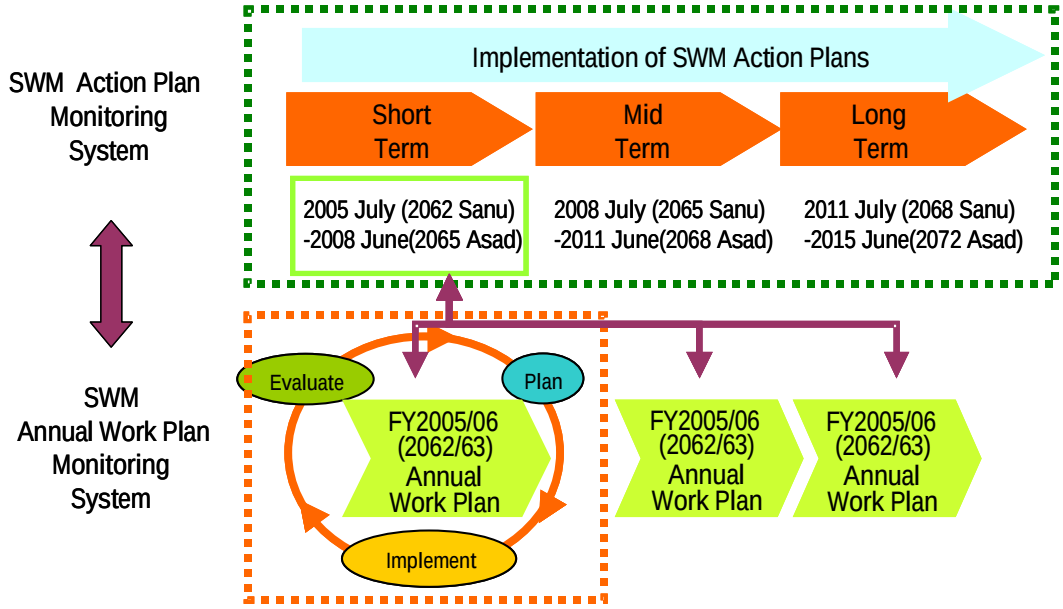


Figure 2.1-1 Overall Monitoring System of Action Plan

Source: JICA Study Team

2.2 Monitoring of Phase 4

The Monitoring of Phase 4 (the Monitoring) was conducted as the first practical exercise of the second level monitoring. The objectives of the Monitoring were:

- To assist effective and steady implementation of the activities of AWPs of the five municipalities and SWMRMC
- To support the five municipalities and SWMRMC to foster a culture of monitoring and evaluation exercises

Basically, the monitoring sessions were carried out by Ttask force together with the JICA Study Team by using a monitoring sheet. Each session also was opened to municipal staffs outside the Task Force, who are assigned to SWM-related responsibilities. Any other participants identified by the municipalities as key personnel were included accordingly.

The following three times monitoring sessions were conducted as the Monitoring followed by sessions for development of AWP of fiscal year 2006/07 (2063/64). The results were fed back to the five municipalities and SWMRMC.

- First Monitoring Sessions (First Monitoring including support of finalization of the AWPs)
- Second Monitoring Sessions (Mid-term Monitoring and Evaluation)
- Third Monitoring Sessions (Final Monitoring and Evaluation)

2.3 Results of Monitoring Sessions

2.3.1 Results of First Monitoring Sessions

The AWP of each the five municipalities was monitored by organizing half day monitoring sessions in November 2005. In the monitoring sessions, AWPs were thoroughly reviewed and some necessary changes of the plans were made as per the actual municipal situation such as viability of the budget and other external circumstances.

The status of the activities including sub-activities (broken-down activities) of the respective AWPs can basically be categorized into the following headings:

- Completed : those activities which had been completed
- Continued: those activities which had been continued from the last fiscal year.
- Started : those activities which had been started since this fiscal year.
- Not started : those activities which are not started yet.
- Canceled: those activities which became unnecessary because of changes of situation
- Postponed: those activities which became impossible to implement this fiscal year because of the lack of budget or equipment or human resource.

The noteworthy observations of the progress are listed below:

- The commencement of scheduled activities was delayed due to delay in the budget approval process. However, except BKM, the other four municipalities had allocated budgets to implement the AWPs.
- Except BKM, the four other municipalities and SWMRMC had allocated enough budget to implement almost all activities in the respective AWPs. Meanwhile, the Municipal Board of BKM had approved only NRs 100,000 to implement the activities in the AWP. BKM explained that the budget proposed by the Board could be changed at the municipal council or the general budget could be allocated in order to implement the activities in the AWP.

2.3.2 Results of Second Monitoring Sessions (Mid-term Monitoring and Evaluation)

The second monitoring sessions were organized in February 2006. Activities including sub-activities (broken-down activities) of the respective AWPs were reviewed and the status of the activities was basically categorized into the same headings as the first sessions. The noteworthy observations of the progress are listed below:

- Frequent changes of political leaders (CEOs/Mayors) tended to delay major activities of AWPs, such as procurement of heavy equipment and organization restructuring, (KMC). The budget release process has been lengthy and it is one of the demotivating factors (LSMC).
- Door to door collection has been newly introduced in Ward No. 2 and Ward No.3 starting Poush (mid December). In addition, Ward No. 20 and Ward No. 5 had been identified as pilot wards for mobilization of Ward Environment Conservation Committee (WECC) on a pilot basis (LSMC).
- Establishment of the SWM section was emphasized as being necessary in MTM, while the SWM unit had been established officially in KRM.

- KRM had called for proposals from private sector organizations with an interest in waste collection. And also, KRM had extended its home composting activities and plastic separation collection to Ward No. 2 and Ward No. 6.
- Examination of the future roles of SWMRMC had started (SWMRMC)

2.3.3 Results of Third Monitoring Sessions (Final Monitoring and Evaluation)

(1) Results of Third Monitoring Sessions

The third, which were the final, monitoring sessions were organized in July and August 2006 in the same manner as the first and second monitoring sessions. Activities including sub-activities (broken-down activities) of the respective AWPs were reviewed and the status of the activities was categorized into the same headings as the first and second sessions. In general, although the progress of some activities had been affected by the unavoidable circumstances of Nepal such as the municipal election and other external factors, responsible staffs have high morale and enthusiasm to carry out the implementation of the scheduled activities. The noteworthy observations of the progress are summarized below.

- The AWP preparation and budgeting has had a distinct impact on the municipal program and budget. The approval of the SWM AWP and budget was obtained by adopting the Program Based Budgeting (PBB) system, which made it easier and clearer to implement SWM activities.
- KRM, MTM and LSMC have high levels of community participation and awareness despite the unfavorable situation whereas lower levels have been achieved in BKM and KMC.
- Political unrest and frequent changes in CEOs have heavily affected the scheduled activities in the AWPs.
- Low commitment and confidence of higher authorities has made it difficult to implement the PPP concept in SWM in all municipalities. However, the municipalities are moving ahead informally in working with the private sector and communities/CBO/NGOs in all municipalities.
- The changes in CEOs have also delayed the implementation of improved organization structures and human resources; nevertheless, staff for the SWM section has been assigned in MTM and KRM. However, recommendations for an agenda on structural adjustment have been strongly put forward during the monitoring session.

(2) Budget and Expenditure

Currently, municipalities have been spending a significant portion of their annual budget for SWM. SWM expenditure is growing annually at relatively higher rates. In the last fiscal year 2005/2006, five municipalities spent about 30% of their budget for SWM.

As for the PBB, which was formulated by the Task Force together with the AWPs, most of the proposed activities as well as the PBB have been approved by the Municipal Councils except BKM. The actual status of the PBB is summarized in Table 2.5-1.

Table 2.4-1 Status of PBB Prepared by the Task Force

In NRs ' 000,000

Municipality	2004/05 (pilot project) (2061/62)			2005/06 (monitoring and follow up) (2062/63)		
	Proposed PBB	Approved PBB	Actual Expenditure	Proposed PBB	Approved PBB	Actual Expenditure
KMC	58.69	58.00	na	32.39	32.39	na
LSMC	2.00	2.00	na	2.96	2.32	2.16
BKM	7.28	1.50	0.08	6.64	0.10	0.10
MTM	2.87	1.50	0.60	2.17	1.50	1.13
KRM	0.86	0.65	0.09	0.95	0.70	0.09
Total	71.7	63.65	0.77	45.11	37.01	3.48

Source: Each municipality

2.4 Annual Work Plan of FY 2006/07 (2063/64) Development Sessions

Each municipality was requested to prepare the AWPs for 2006/2007 (2063/2064) after the evaluation of progress of that for 2005/2006. The JICA Study Team assisted to organize a half or one day workshop at each of the five municipalities to facilitate preparation of the respective AWPs in July and August 2006. At the workshops, the JICA Study Team together with Task Force members confirmed the staff (responsible persons) and possible budget arrangements for solid waste management, and then confirmed the activities to be implemented in the fiscal year of 2006/07(2063/2064). Finally, activities including sub-activities (broken-down activities) of the respective AWPs of fiscal year of 2006/2007 (2063/64) were prepared by each Task Force together with the JICA Study Team through a series of the AWP development sessions.

2.5 Recommendation for Further Effective Implementation of Action Plans

Based on the results of the monitoring and evaluation, and AWP development, the following are recommended for further effective implementation of APs:

- Planned or scheduled activities in AWPs have been heavily affected by the political unrest (absence of elected representatives, nomination of Mayors, election of representatives, people's movement and dissolution of the elected body) and frequent change of CEOs. It is recommended that structure and components of the AWPs be reviewed and reformulated in the present changed context. The formulation process, representatives and TOR of the Task Force should be based on the present situation, rules and regulations.
- The internal monitoring system has not been fully established in municipalities. It may take time to enroot such organizational culture in each of the five municipalities. It is therefore recommended to introduce merit-basis support linked to a mandatory planning, monitoring and reporting system. The long- term planning- annual programming - budgeting - implementing - evaluation cycle should be practiced in the municipality.
- It seems that responsible staff have high morale and enthusiasm to carry out the implementation plan but policy level staff have less commitment to the activities. The Study has emphasized the influence of the structural provisions for SWM and its effective operation. However, the SWM Section/Sub section/Unit in BKM, MTM and

KRM need to be more effectively operationalised. One reason is that the staff previously had different SWM roles and responsibility of the old roles dominates or marginalizes the new roles. LSMC has assigned an engineer solely to the SWM section to clarify roles and make it more effective. It is therefore recommended to have fully dedicated staff for the SWM section/subsection/unit with clear roles, responsibility and SWM plan.

- The Study has established clarity on SWM approaches and strategies in the municipality. AWP preparation and budgeting has distinct impact on the municipal program and budget for SWM. However, the daily activities, such as regular operation (maintenance) and development aspect, have not been covered in the AWP. All aspects of SWM should be covered in the AWP and the program based budget so that the institutionalization of the AWP will be stronger. Therefore it is recommended that the AWP should cover all SWM activities and be fully integrated with a program based budget.
- The Action Plan should be formulated on the basis of the present reality. Regular periodic review and amendment of the AP is necessary. In reality, provision for periodic review and mid term review of the AP from the central government may help implementation of the AP.

CHAPTER 3 FOLLOW-UP FOR ACTION PLAN IMPLEMENTATION

3.1 Follow-up for Collection and Transportation in BKM and MTM

3.1.1 Source Separated Collection in BKM

(1) Current Situation

The pilot project "Source Separated Collection" was launched in May 2005. So far, the project has been implemented in two wards of BKM, that is ward No. 14 (Tanani) and Ward No. 17 (Bharbacho). Two nature clubs in Tannani and another two clubs in Bharbacho have been formed to motivate and accelerate the source separation activities. The green bucket is for organic waste and the red bucket for inorganic waste. Every morning, BKM staff come to collect the organic waste and inorganic waste separately.

(2) Implemented Follow-up Activity

1) Tanani Source Separation Area

There are 50 households in Tanani and all households are around the chowk (Tanani Chowk) and the waste collector goes to the chowk for collection. Collectors collect the organic waste and inorganic waste separately and record the number of buckets that have been poured into the waste in the tricycle or waste sack. The collectors do not have to move here and there to individual households for waste collection as household members come to the collecting site.

A time and motion survey was carried out. The total time taken for waste collection from start to coming back to the Composting Plant was one and a half hours. As they reach to the Composting Plant they take the record (weight) of organic and inorganic waste and a detailed breakdown of the weight of inorganic waste. The average production of organic waste is 0.693 kg/day/family but that ranged from 0.330 kg (Dec.-Jan.) to 0.856 kg (Oct.-Nov.). The average inorganic waste production was 0.414 kg/day/family but it ranged from 0.327 kg/day/family (July-Aug.) to 0.459 kg/day/family (Oct.-Nov.).

2) Bharbacho Source Separation Area

There are 134 households in Bharbacho and collector has to go down several small streets (gally) to collect the waste.

The total time for collection of waste in Bharbacho was one hour and 40 minutes; 40 minutes for travel and one hour for waste collection. The average production of organic waste is 1.870 kg/day/family but that ranged from 1.420 kg (July-Aug.) to 3.610 kg (Dec.-Jan.) and the average inorganic production was 0.710 kg/day/family. Bharbacho area produces relatively higher amounts of organic and inorganic waste. The average inorganic waste production was 0.413 kg/day/family but it ranged from 0.345 kg/day/family (July-August) to 0.574 kg/day/family (Oct.-Nov.).

(3) Perception of Beneficiaries on Source Separation

1) Sampling Size and Sample Site of Household Survey

The household survey was conducted to the people of Tanani and Bharbacho areas. Seventeen households were interviewed. The sample households were deliberately selected for interview from those who were involved in the source separation activities.

2) Organic Waste Production Rate in the Households

The household survey has indicated that about 0.880 kg of organic wastes are produced per household and the proportion of organic and inorganic waste was 56 to 44 % respectively (Table 3.1-1).

Table 3.1-1 Organic Waste Production in Households

Sample Site	Home Organic Waste Production (kg/day)			Proportion of Waste in House (%)			All Waste given for Collection (%)	
	Green	Red	Total	Organ.	Inorg.	Total	Yes	No
Tanani Area (W. No. 14)	0.695	0.673	1.369	53.9	46.1	100.0	52.9	47.1
Bharbacho Area (W. No. 17)	1.071	0.866	1.938	58.3	41.7	100.0	82.4	11.8
Overall	0.883	0.770	1.653	56.2	43.8	100.0	67.6	29.4

Source: JICA Study Team

3) Collection and Transportation Waste

In the source separation area the wastes are collected and information are recorded daily. About 68% of households reported that waste taken by the waste collector daily, 26% said that waste were pick-up after each third day and some (6%) said alternate day and other (3%) told weekly.

About timing of the pick-up of waste, 94% households reported that the pick-up of wastes is timely and 97% of the households expressed their appreciation by saying that waste collection is going properly and effectively.

Table 3.1-2 Collection and Transportation of Waste

Sample Site	When is your waste taken by Collector? (%)				Pick-up waste timely? (%)		Is waste collection effective ?(%)		Reasons for effectiveness*? (%)			
	Daily	Alt. day	After 2 days	Weekly	Yes	No	Yes	No	1	2	3	4
Tanani Area	88.2	0.0	11.8	0.0	100.0	0.0	94.1	5.9	35.3	35.3	64.7	5.9
Bharbacho Area	47.1	11.8	41.2	5.9	88.2	11.8	100.0	0.0	0.0	52.9	94.1	47.1
Overall	67.6	5.9	26.5	2.9	94.1	5.9	97.1	2.9	17.6	44.1	79.4	26.5

Note: *1=Organic for compost preparation; 2=Waste minimization; 3=Clean Tole/locality; and 4=Good environment.
Source: JICA Study Team

4) Opinion on Source Separation

The main objective of source separation is to promote reuse or recycle or reduce waste. With concern to these issues, 94% of households said that source separation has helped to clean area/locality and 26% said that they are using organic waste for composting and 9% said it has helped provide a good environment (Table 3.1-3). All respondents were in favor of continuing the program and expanding the program into other localities. The evidence shows that the program is starting to pick-up and doing better.

Table 3.1-3 Opinion on Source Separation

	Good Point of Source Separation* (%)				You are supportive to Source Separation(%)		Opinion about Source Separation Activities**(%)			
Sample Site	1	2	3	4	Yes	No	1	2	3	4
Tanani Area	41.2	88.2	5.9	0.0	100.0	0.0	100	0.0	0.0	0.0
Bharbacho Area	11.8	100.0	11.8	0.0	88.2	11.8	100	0.0	5.9	0.0
Overall	26.5	94.1	8.8	0.0	94.1	5.9	100	0.0	2.9	0.0

Note: *1=Organic and Inorganic separated; 2=To keep clean Home/area; 3=Good Environment, 4=Others
**1=Continue program, 2= Economic benefit, 3= Better environment, 4=Others
Source: JICA Study Team

3.1.2 Collection and Transportation Practice in MTM

(1) Current Situation

The pilot project "Practice of Waste Collection and Transportation" was launched in June 2005. The target areas for collection were determined by MTM in the core areas of the Municipality, which are currently covered by the municipal sweeping service, and Kathmandu-Bhaktapur High Areas (Arniko Highway). The sweepers collect waste and dirt in each collection point prior to the truck reaching the point and the loader just picks up the waste and puts it into the dump truck. Others neighboring can also put their waste directly on the truck when it is moving on the collection route.

(2) Implemented Follow-up Activity

1) Time and Motion of Waste Collection and Transportation Activities

The time and motion of transportation was monitored starting from MTM chowk to Teku T/S. The total time taken for the whole activity was one hour and 53 minutes; collection time 57 minutes, movement time 56 minutes and total distance covered was 11.5 km.

2) Waste Collected and Transported to T/S, Teku.

The total waste record received from MTM was based on data of Teku T/S. MTM has no facility for waste weighing. The average monthly weight and daily weight is given in the Table 3.1-4. The monthly average weight ranged from 26,125 kg (Dec./Jan.) to 42,755 kg (Sept./Oct.), and the monthly average (average of 6 month) was 32,916 kg and the daily

average of wastes collected was 1,097 kg. The collection amount is about half of the proposed amount therefore there may be some problems somewhere, either in sweeping or the truck not being regular enough in timing of waste collection, or the point of waste collection not being centrally located.

Table 3.1-4 Waste Collected and Transported to Teku T/S

Month (Nepali)	Month (English)	Total Solid Waste Transported (kg/month)	Average Solid Waste Transported (kg/day)
Bhadra	Aug.-Sept.	34,200	1,103
Ashwin	Sept.-Oct.	42,755	1,379
Kartik	Oct.-Nov.	34,235	1,181
Mangsir	Nov.-Dec.	28,435	948
Paush	Dec.-Jan.	26,125	901
Magh	Jan.-Feb.	31,745	1,058
Total/Average		197,495	1,097

Source: MTM, records from data from Teku Transfer Station, KMC

3) Operational Cost of Collection and Transportation of Waste

The operational cost includes the salary of the two loaders (half time) and truck hiring cost. The loaders work morning shift in the collection and transportation and in the afternoon work in the office as sanitary staff. The truck is hired, costing Rs 41,000/month (inclusive of driver and fuel). The operational cost for collection and transportation is Rs 44,000/month.

(3) Perception of People on Waste Collection and Transportation

1) Household Survey

Thirty target households (30 households) were interviewed in the core area and highway area and another 20 households were interviewed from the private collection area. The sample households were deliberately selected for interview from those who have houses near a collection site or a private collection site.

2) Waste Collection Timing and Performance

The survey result has shown that 74% of households have reported that collections are being done daily and rest of the households (40%) said that waste collection is done on alternate days. 83% of MTM collection people said that collections were done daily but 60% of people with private collections reported collection as daily and 40% reported it as being on alternate days (Table 3.1-5).

The respondents have expressed their views saying that the private collector has given better service than MTM but also that MTM is now performing better. 95% of the private collection beneficiaries expressed their opinion that they are satisfied with private collectors

while 80% of MTM beneficiaries said that they are also satisfied with MTM service but 20% said MTM service has not improved.

Table 3.1-5 Waste Collection Timing and Performance

Sample Area	Waste Collection (%)			Vehicle comes in time for Collection (%)		Where do you take waste for Collection (%)				Waste Collection Performance (%)		
	Daily	Alter.	1/W	Yes	No	Road Side	Come for Collection	Take to Van	Sweeper Pick-up	Good	Sats.	Not Improved
MTM Collection Area	83.3	16.7	0.0	96.7	3.3	80.0	6.7	13.3	3.3	30.0	50.0	20.0
Private Collection Area	60.0	40.0	0.0	50.0	50.0	10.0	70.0	20.0	0.0	20.0	75.0	5.0
Overall	74.0	26.0	0.0	78.0	22.0	50.0	32.0	16.0	2.0	26.0	60.0	14.0

Source: JICA Study Team

(4) Recommendations

1) Source Separation Activities

- The source separation collection activities have to be expanded in other core areas.
- The sustainability is the main concern of the activties. BKM should collect a higher quantity of organic waste, and try to produce more than 50 kg of compost per day to help sustain the project.
- BKM should strengthen the composting capacity or employ an expert for its operation and production and marketing of solid waste compost.
- BKM should maintain records of source-separated compost production and compost sales.

2) Waste Collection and Transportation

- It is the responsibility of MTM to keep the city area clean, so the municipality has to arrange a vehicle and manpower to continue collection and transportation.
- MTM has to manage manpower for sweeping and collecting the waste.
- The collection areas have to be increased and a new collection method for the other core areas, which currently do not have a municipal transportation service, has to be considered.
- The starting time and arrival time at each of the sites has to be fixed and strictly enforced.
- The schedule of the truck has to be fixed as well and there should be clear instructions that the truck can not move anywhere else before a given time. Otherwise the driver will go freely and as fast as possible to complete the round in the earliest possible time and then go for other business.
- The quantity of the waste transported by the truck should be monitored.

3.2 Follow-up for Waste Minimization Activities

3.2.1 Development of Waste Minimization Facility

The SWMRMC has made efforts to locate candidate sites for the waste minimization facility. However, so far not much progress has been made with the development of the facility. The SWMRMC and KMC should continue with efforts to solve the issues related to the site selection, as well as others, for construction of the waste minimization facility.

3.2.2 Local Level Waste Minimization Activities

(1) Operation of Medium-scale Vermi-composting

KMC has established a medium-scale vermi-composting plant in the Teku T/S's premise and it has been in operation since March 2005. KMC is also working with general composting, such as pile and box composting in the vermi-composting premises. The organic waste used for composting was 77.4 tons for 13 months and production was 6.4 tons. Gross return from sale was Rs 36,184 as shown in Table 3.2-1.

Table 3.2-1 Production Records of Vermi-composting Plant

Year	Month		Input for Composting (kg)	Compost Production (kg)			Compost Sale (kg)			Return from Compost Sale (Rs)		
	(Nepal)	(Gregorian)		Vermi	General	Total	Vermi	General	Total	Vermi	General	Total
2005/2062	Ashaf to Shrawan	Jun.-Jul. Jul.-Aug.	(12000)*	-	-	916	55	0	55	575	0	575
	Bhadra	Aug.-Sept.	5260	327	118	445	496	0	496	4474	0	4474
	Ashwin	Sept.-Oct.	7810	299	310	609	38	1	39	466	10	476
	Kartic	Oct.-Nov.	5648	341	232	573	5	20	25	70	140	210
	Mansir	Nov.-Dec.	7450	368	87	455	30	200	230	317	1220	1537
	Paush	Dec.-Jan.	6500	295	178	473	67	45	112	764	315	1079
2006	Magh	Jan.-Feb.	16520	219	227	446	543	1179	1722	4956	7014	11970
	Falgun	Feb.-Mar.	4670	343	102	445	-	-	-	-	-	3017
	Chaitra	Mar.-Apr.	9003	134	564	698	-	-	-	-	-	6449
2063	Baisakh	Apr.-May	1850	258	510	768	-	-	-	-	-	3311
	Jestha	May-Jun.	664	121	212	333	-	-	-	-	-	2571
	Ashad	Jun.-Jul.	0	200	62	262	-	-	-	-	-	515
Total			77375	3371	3051	6421	-	-	-	-		36184

Note:* Estimated value

Source: Vermi-composting Plant, Teku, KMC

The followings are recommended for ensuring the sustainability of plant operation:

- Supplies of vegetable market waste to the plant by KMC should be secured.
- Labor conditions also should be improved, for example the salary of staffs/workers should depend on the amount of compost produced, to increase motivation.
- Considering above-mentioned matters, it is recommended that the vermi-composting plant should be managed by a suitable NGO or private agency.

(2) Operation of Community Recycling Center (CRC)

A CRC has been run by KMC at Lagan, KMC-21. The main work of the CRD is to buy and store recyclable materials and also to sell flower cuts and vermi-compost etc. The quantity of recyclable materials purchased in the CRC is less than Rs 750/month in average as shown in the Table 3.2-2.

Table 3.2-2 Recyclable Materials Purchased at CRC

Month		Plastic		Papers		Metals		Bottles		Total
(Nepal)	(English)	Quantity (Kg)	Amount (Rs)	Quantity (Kg)	Amount (Rs)	Quantity (Kg)	Amount (Rs)	Quantity (No.)	Amount (Rs)	Amount (Rs)
Ashadh	Jun.-Jul.	49.5	405.0	87.1	337.0	10.5	168.0	75.0	75.0	985.0
Shrawan	Jul.-Aug.	46.7	280.0	28.0	95.0	10.3	155.0	44.0	110.0	640.0
Bhadra	Aug.-Sept.	30.7	313.0	114.2	352.0	41.0	294.0	82.0	200.0	1159.0
Ashwin	Sept.-Oct.	34.7	279.0	80.5	204.0	na	na	129.0	244.0	727.0
Kartic	Oct.-Nov.	34.8	411.0	30.2	121.0	6.5	64.0	62.0	159.0	755.0
Mansir	Nov.-Dec.	43.0	368.0	25.6	66.0	20.0	169.0	27.0	50.0	653.0
Paush	Dec.-Jan.	51.3	461.0	4.0	13.0	2.6	32.0	50.0	85.0	591.0
Magh	Jan.-Feb.	24.2	326.0	0.5	5.0	2.5	21.0	11.0	22.0	374.0
Total		314.9	2843.0	370.1	1193.0	93.4	903.0	480.0	945.0	5884.0

Source: KMC/CMU

The followings are recommended for sustainable operation of the CRC:

- A catch phrase on recycling of waste such as “Recycling solves the waste issues and changes trash to cash” should be shown on the CRC booth.
- The purchase price list for recyclable materials including household made compost should be indicated on the CRC booth and distributed with above-mentioned catch phrase.
- The CRC should not only be a recycling center, but also an information center on solid waste management at the community level.

(3) Plastic Separation Activities

Plastic separation activities have been implemented from October 2004 in KRM. Suiros have been distributed for household plastic collection as shown in the Table 3.2-3.

Table 3.2-3 Suiro Distribution Number

Name of Group	Ward	Suiro Distribution (Nos.)	Remarks
Thambahal Misa Puchaa	No. 1	60	
Community Youth Club	No. 5	50	
Yuba Jankalyan Youth Club	No. 14	75	
Shansriti Jagaran Samuh	No. 7	70	Newly formed
Total	-	255	

Source: KRM

Local women's group members separate plastic from waste in each house and youth groups collect the plastic. KRM collect, store and sell the plastic. The total quantity sold was 252 kg, which amounted to Rs 2,274 as shown in Table 3.2-4.

Table 3.2-4 Amount of Plastic Collected and Sold to Scrap Dealers

Collection Times	Month	Plastic Sale	Plastic Sold	
			Quantity (Kg)	Amount (Rs)
1st	Mar-05	1st	81	745
2nd	Jun-05			
3rd	Jul-05	2nd	171	1,529
4th	Aug-05			
5th	Nov-05			
Total			252	2,274

Source: KRM

The plastic separation activity has been recognized worthwhile and people are motivated to conduct the separation work and earn some money out of waste materials.

(4) Home Composting Activities

After the Study, each municipality has been promoting home composting activities by their own budget. The number of households using HCB is estimated to be approximately 3,120 households in total as shown in Table 3.2-8. This means that approximately 1.6% of households are making compost from organic waste and consequently waste discharged is simply estimated to be reduced by approximately 1.1%.

Table 3.2-5 Number of HCB Used in Five Municipalities

Municipality	KMC	LSMC	BKM*[1]	MTM*[2]	KRM	Total
No. of Household using HCB (A)	2,000	800	10	150	120	3,080
No. of Household in total (B)	132,000	32,000	14,000	10,000	8,000	196,000
Composting Household Ratio (A/B %)	1.5%	2.5%	0.1%	1.5%	1.5%	1.6%

Source: Each municipality

According to the result of household survey conducted in May 2006, 86.7% of households reported that the compost preparation takes about 2.5 months or less. They are satisfied with the present bins and compost quality as shown in Table 3.2-6.

Table 3.2-6 Duration for Composting, Attitude of Households and Compost Quality

(Unit:%)

	Duration for Compost Preparation Months				Happiness of HCB Use			Quality of Produced Compost			Purpose of Compost Making			
	<2.0	2.5	3	3.5	Happy	NH	FD	Good	Average	NI	Home Garden	Agri. Use	Income Gener.	Envir. & Pollution
KMC Average	0.0	100.0	0.0	0.0	100.0	0.0	0.0	71.4	28.6	0.0	71.4	0.0	14.3	85.7
LSMC Average	30.0	50.0	20.0	0.0	100.0	0.0	0.0	40.0	60.0	0.0	90.0	5.0	5.0	30.0
KRM Average	0.0	100.0	0.0	0.0	100.0	0.0	0.0	66.7	33.3	0.0	100.0	100.0	0.0	100.0
Overall Average	20.0	66.7	13.3	0.0	100.0	0.0	0.0	50.0	50.0	0.0	86.7	13.3	6.7	50.0

Note: NH = Not happy, FD = Family disagree ness, NI = No idea, NG = Not good.
Source: Household Survey, May 2006

The following are recommended for home composting activities:

- Municipality should subsidize HCBs as appropriate as possible so that residents can acquire one easily in cheaper price, but should also motivate composting operation by sharing a certain amount of bin cost.
- Periodical monitoring and advice should be done by employing motivators. Trouble shooting for composting operation should also be done quickly and surely.
- HCBs and the operation manual should be improved according to operational experiences.
- Municipality should arrange places/opportunities, like the CRC, for those who want to sell the compost product for earning money.
- Considering the present situation that some compost products are being sold at markets/shops, the sales market of the compost products is expected to be secured. Since the result of the market survey conducted in the Study revealed that there is a potential for use of compost by farmers in and around the valley, Municipalities should also monitor and encourage the sales market of the compost products continuously.
- Effectiveness of the home compost product in crop growth should be studied continuously and demonstrated to bin users.
- Information on not only home composting but also other waste minimization activities should be shared through CoMoN meeting periodically.

3.3 Follow-up for Solid Waste Data Management

(1) Current Situation

At the beginning of this Monitoring and Follow-up, the present status of utilization of the DBMS was monitored through the meetings and interviews.

Table 3.3-1 Current Status of DBMS at the Five Municipalities

Municipality	Status
KMC	・ KMC is using DBMS developed under the Study. ・ However, besides DBMS, other systems at Teku transfer station and Sisdol Landfill are also used in addition to the existing system that used to be used. This situation makes some confusion to SWM section. ・ Lack of skilled manpower because the trained staff were transferred to another section.
LSMC	・ DBMS is being used by environmental section very successfully. ・ Up to now, the database is always updated by the daily collected data. ・ LSMC is preparing monthly reports on solid waste from the updated database ・ Additional manpower for data entry is required.
BKM	・ There is a hardware problem to be fixed with the PC. ・ However, BKM started preparing the database using DBMS in another PC. ・ BKM prefers to use DBMS as the database for the source-separated collection. ・ There is still lack of skilled manpower to enter the data into the system
MTM	・ MTM has used DBMS only to keep inventory of their handbarrows. ・ MTM does not collect the day-to-day data to keep the database updated. ・ Data to be managed by MTM is very limited, only the waste quantity transported to Teku T/S
KRM	・ Waste is only collected by the private sector in KRM, but there is no coordination of database management between the private sector and the municipality. ・ It has not been determined who should have responsibility of data entry to DBMS, KRM or the private sector.

Source: JICA Study Team

(2) Implemented Follow-up Activity

A First Follow-up Workshop was held on March 1, 2006. After discussion the participants to the workshop concluded that the focus should be to improve the DBMS because establishment of the reliable database system should be prior to the estimation practices for the waste generation.

In June 2006, a monitoring meeting was held at each municipality. Based on this monitoring meeting, the general training schedule was determined. A training needs assessment was also carried out in each monitoring meeting and the training details customized for each municipality as a result of the assessment.

A Second Follow-up Workshop was held on July 31, 2006. Those focal points presented the progress of the DBMS, the present skill of the trainees and sample formats for the generation of annual reports based on the available six-month data of LSMC and MTM.

(3) Recommendations

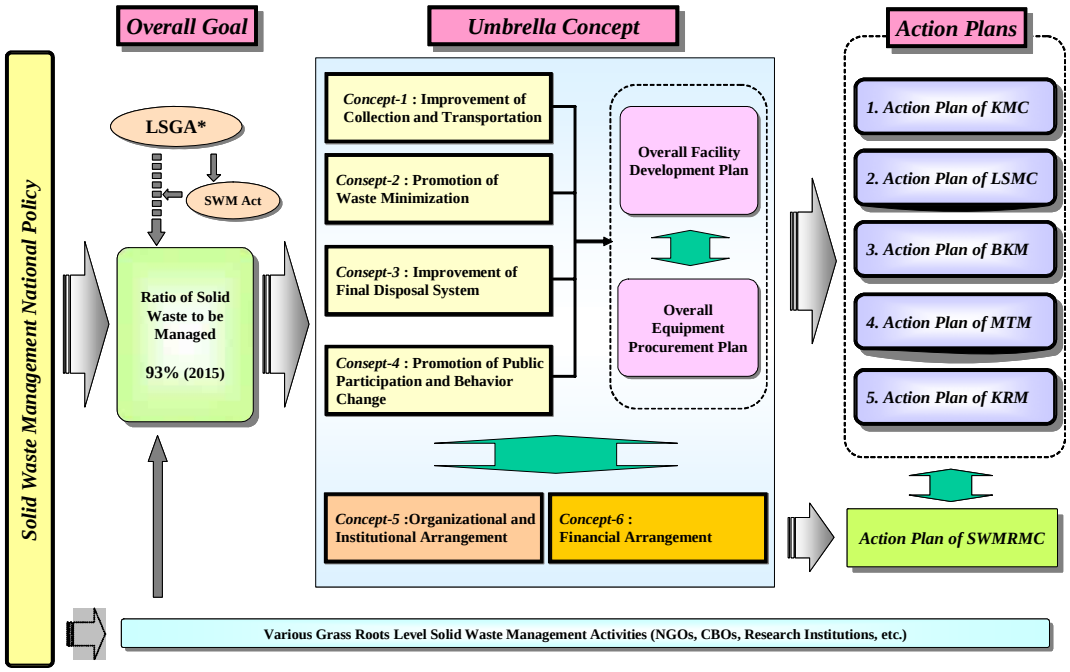
- Preparation of a data merging and integration system for combining the recording system of the weighing bridge at Sisdol S/T-LF and Teku T/S with the DBMS used by the municipalities. At the final stage of the DBMS particularly KMC has demanded for fully automatic data recording from weighing bridges at Sisdol S/T-LF and Teku T/S through an online network system.
- It is strongly recommended for municipalities to secure the budget for maintenance and upgrade of the system and to resist sudden/irresponsible transfer of staff, which interrupts the continuation of operation and utilization of skills.
- Another expected outcome from this DBMS activity is to compile the solid waste data at each municipality to prepare the "Solid Waste Management White Paper" by the SWMRMC. Therefore, it is recommended for the SWMRMC to organize the information exchange meeting among the municipalities and the SWMRMC at least once a year.

CHAPTER 4 FOLLOW-UP FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS FOR FACILITY DEVELOPMENT

4.1 Overall Facility Plan in the Kathmandu Valley

4.1.1 Umbrella Concept for Solid Waste Management in the Kathmandu Valley

A basic concept common for all five municipalities, *an umbrella concept for solid waste management in the Kathmandu Valley (Umbrella Concept)*, has been proposed to clarify the administrative responsibilities of each municipality and to show a basic direction (road map) for effective solid waste management. As parts of the Umbrella Concept, an overall facility plan (OFP) and overall equipment plan (OEP) in the Kathmandu Valley have been discussed. The overall framework of the Umbrella Concept is shown in Figure 4.1-1.



Note: * Local-self Governance Act

Figure 4.1-1 Overall Framework for the Umbrella Concept of the Kathmandu Valley

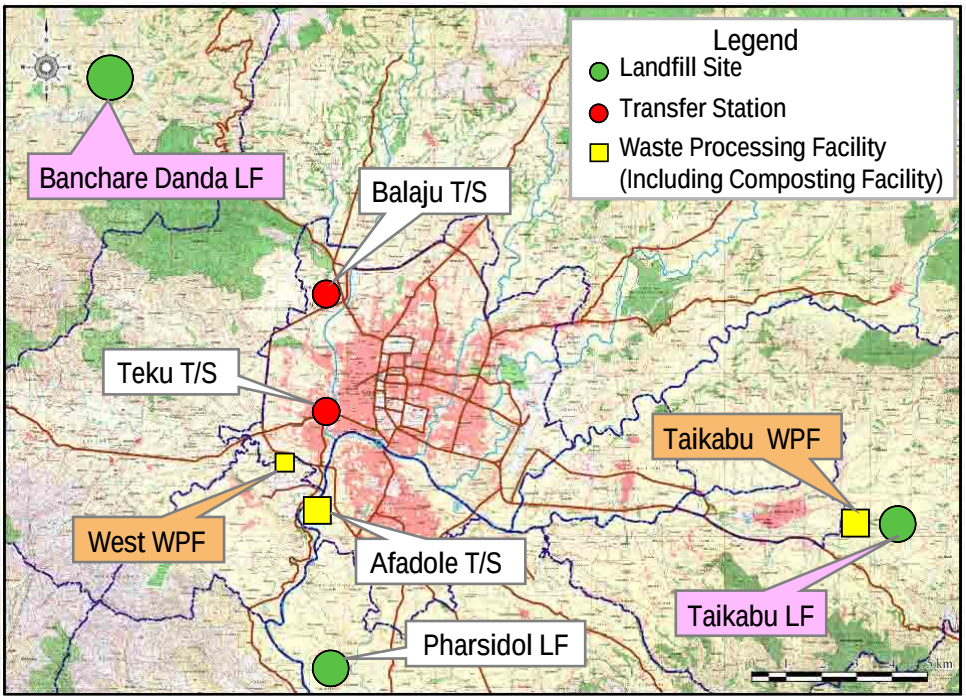
Source: JICA Study Team

4.1.2 Overall Facility Plan in the Kathmandu Valley

(1) Alternative Evaluation of OFP

As a first step, a short list of candidates for long-term landfill sites (L/T-LFSs) was prepared based on the 1998 study by the Department of Mines and Geology (DOMG). The four candidate sites, Pharshidol South, Pharshidol North, Taikabu, and Okharpouwa (Banchare Danda), for development of long-term sanitary landfill were selected considering rapidly progressing development in and around each site.

The facilities to be incorporated in the formulated alternatives mostly reflect existing plans and nine alternatives, to suit the number of landfills, were analyzed. Figure 4.1-2 shows the locations of these facilities.



Source: JICA Study Team

Figure 4.1-2 Facilities incorporated in the Alternatives 1-3

Since the analysis indicated that two landfills and two WPFs would provide stable and sustainable SWM service for the Kathmandu Valley. Accordingly, the OFP in Zone A (KMC, LSMC and KRM) and Zone B (BKM and MTM) are described in Table 4.1-1.

Table 4.1-1 Overall Facility Plan under the Umbrella Concept

Facilities		Descriptions
ZONE A – KMC, LSMC and KRM		
1	Sisdol LF	
	(1) Valley 1	Valley 1 (PP C-2) will be operated for about 12-14 months
	(2) Valley 2	Valley 2 to be developed and operated for about 12 months
	(3) Post closure	Upon completion of disposal operations at Sisdol proper site closure will be implemented and environmental monitoring will continue as long as required
2	Bagmati Dumping Site	Bagmati dumping site will cease operation once the new transfer trucks arrive and all the waste is transported to Sisdol LF. For a couple of years thereafter, safe closure works will be implemented along the Bagmati River banks where waste has been deposited.
3	Banchare Danda L/T-LF	This LF is expected to be developed within the next three years. It will be operated as a Level 3, semi-aerobic landfill.
4	Waste WPF	A WPF, basically for compost production but that will also include recyclable materials separation facilities to be developed west of KMC and LSMC and within 7-10 Km distance. The facility will be developed in three phases, starting with an input capacity of 100 t/d and reaching 300 t/d. Residues will be transported from the plant to the landfill
5	Teku T/S	Teku T/S has been improved with a capacity of 200 t/d (40 t at peak hour). Tipping at the station will continue to be mixed with some loading by wheel loaders.
6	Balaju T/S	Balaju T/S will be developed on the allocated land. It will be a split level unloading system without compaction. It will have a capacity of 120 t/d.
7	Afadol Temporary T/S	For the first 2-3 years of the Action Plan period, a temporary T/S will be developed for LSMC waste at Afadol. Upon completion of the waste processing facility the LSMC waste will be transported there.
Zone B – BKM and MTM		
1	Hanumante dumping site	For the next 2-3 years waste will continue to be dumped at Hanumante River bank, with the application of cover soil.
2	MTM temporary LF	The solid waste collected in the central areas will be transported to Teku T/S, while remaining waste will be disposed of at a temporary landfill with the application of cover soil.
3	Taikabu LF	The Taikabu LF will be developed within the next 2-3 years as a Level 3, semi-aerobic landfill.
4	Taikabu WPF	Within the same Taikabu LF site, a compost plant will also be developed. The plant will have an initial capacity of 10 t/d and expand to 15 t/d.

Source: JICA Study Team

4.1.3 Environmental and Social Considerations for Facility Development

(1) EIA System in Nepal

The legal framework of the EIA system in Nepal is basically composed of the Environmental Protection Act, 1997 (EPA) and the Environmental Protection Rules, 1997 (EPR). Article 3 of the EPR stipulates that a project proponent should conduct an IEE or EIA study before the commencement of project. Table 4.1-2 shows the project type and activity in the SWM sector for which the IEE/EIA is a prerequisite in accordance with the EPA and EPR.

Table 4.1-2 IEE/EIA Requirement on SWM Sector in Nepal

Project Type and Activity		Size/capacity requiring IEE	Size/capacity requiring EIA
1	SWM activities[*1]	Population under service: 2,000-10,000	Population under service: More than 10,000
2	Landfill	Receiving waste: 100-1,000 ton/year	Receiving waste: More than 1,000 ton/year Population under service in urban area: More than 10,000
3	Transfer station and resource recovery	Area: Not more than 3 ha	Area: More than 3 ha
4	Facility for selecting, picking, disposing, and recycling through chemical, mechanical or biological techniques	Area: Not more than 2 ha	Area: More than 2 ha
5	Compost plant	Area: 1-5 ha	Area: More than 5 ha
6	Construction of waste plant, recovery plant, landfill site, storing facility and treatment facility for hazardous waste	-	Any scale
7	Final disposal of infectious waste	-	Hospital, health center, etc.: More than 25 beds
8	Incinerating or recycling any lethal substances	-	Area: More than 1 ha

Note *1: Although there is no legal definition in EPA/EPR in terms of SWM-related activities, it can be technically said to include waste collection, transportation, processing, final disposal and any combination of them, according to MOEST.
Source: Environmental Protection Act, 1997, and Environmental Protection Rules, 1997, HMG Nepal

In addition, the SWMRMC has developed EIA Guidelines for Solid Waste Management Projects in the municipalities of Nepal (SWMRMC EIA Guidelines) in 2004. The guidelines mainly cover the scope of municipal SWM and contain technical and procedural requirements.

(2) Land Acquisition and Resettlement Systems in Nepal

A legal framework on land acquisition and resettlement in Nepal is mainly formed by the Land Acquisition Act 1961 (amended in 1977) and Land Acquisition Rules 1969. The Act empowers the government to acquire any land for public purposes and works on the payment of compensation. The acquisition of and compensation for privately owned property are undertaken according to a formal procedure, consisting of i) initial procedure, ii) preliminary investigation process, iii) notice of acquisition, and iv) compensation.

On the other hand, there is no specific legislation on involuntary resettlement in Nepal. The resettlement or relocation due to public purposes or works is in practice operated within the conceptual framework of land acquisition and compensation.

(3) Preliminary Screening

Among various proposed activities in the A/Ps, the activities associated with facility development are selected as the projects (activities) necessary for preliminary screening as shown in Table 4.1-3.

Table 4.1-3 Target Activities for Preliminary Screening

Municipalities	Target Activities based on the A/Ps	Activity Number
KMC	Development of Balaju T/S	PS-1
	Development of a waste processing facility (WPF) (specific site is not decided yet.)*1	PS-2
	Development of long-term LF (Banchare Danda site in Okharpauwa)*2	PS-3
LSMC	Development of Afadol temporary T/S	PS-4
	Development of a waste processing facility (WPF) (specific site is not decided yet.)*1	PS-2
	Development of long-term LF (Banchare Danda site in Okharpauwa)*2	PS-3
BKM	Development of Taikabu LF	PS-5
MTM	Arrangement of temporary LF (specific site is not decided yet.)	PS-6
KRM	Development of a community composting facility (Specific site is not decided yet.)	PS-7

Note: *1: Both activities are the same under the umbrella concept
*2: Both activities are the same under the umbrella concept

Source: JICA Study Team

Based on the available data and information in terms of the existing environmental and social conditions in and around the areas of each target activity, a preliminary examination of the magnitude of impacts was conducted considering the expected characteristics of each activity. As the results of the preliminary screening, the legal requirements of Nepal are that IEE/EIAs are required for PS-1-5 while for PS-6-7, the IEE/EIA requirement is dependent on the scale and location.

(4) Target Facilities of the Follow-up

Among the above discussed facilities, the EIA procedures of Taikabu LF have been undertaken by BKM including a series of consultations with local people and communities with support from the SWMRMC. The specific locations for a WPF, a temporary LF in MTM, and a community composting facility in KRM, have so far not been fixed. On the other hand, locations of a long-term landfill site for zone A (KMC, LSMC and KRM) and transfer stations at Balaju in KMC and Afadole in LSMC have been identified and commencement of the procedures to develop these facilities is urgently required. As careful environmental and social considerations for the development of these facilities including official procedures for IEE/EIA are required, a follow-up survey of environmental and social considerations has been conducted as technical support to the Nepalese counterparts.

4.2 Follow-up for EIA on Banchare Danda Long-term Landfill Site

4.2.1 Guidelines for Environmental and Social Consideration of JICA

As upstream decision making with integration of adequate environmental and social considerations became important, JICA revised its former guidelines and made the Guidelines for Environmental and Social Considerations (JICA Guidelines) which started to come into force from April 2004. The JICA Guidelines aim at encouraging a recipient government to conduct appropriate environmental and social considerations in various stages of the study or project preparation, through making clear the responsibility and process to be taken by JICA and necessary conditions to be fulfilled by the recipient country.

The category for the Study has been changed from "B" to "A" in which strict environmental and social considerations are required under the JICA Guidelines since the Monitoring and Follow-up phase. This is because the planned long-term landfill sites need EIA under the EIA regulations of Nepal and careful environmental and social considerations are required. The documents related to the EIA such as Scoping Report, TOR for EIA as well as reports produced by the JICA Study Team were reviewed by the Advisory Council of Environmental and Social Considerations Review of JICA (Advisory Council). The Nepalese side is kindly requested to incorporate comments made by the Advisory Council into the EIA report.

4.2.2 Contents of the Follow-up Survey for EIA on Banchare Danda Landfill Site

The EIA procedures on Banchare Danda landfill site including detailed study on the environmental impacts and mitigation measures will be completed by the SWMRMC. However, since careful studies and examinations on the environmental and social considerations are required, the JICA Study Team provided technical support for topography, soil investigation, geological, hydrological and supplemental environmental surveys, and concept design for going forward with the EIA procedure appropriately as a follow-up activity.

The JICA Study Team recommended that the SWMRMC include the following conditions into the TOR for the consultant procurement:

- Detail description of site selection process for the landfill in the EIA report
- Detail description of public involvement such as public hearings in the EIA report
- Detail description of land acquisition and resettlement procedures and plan in the EIA report
- Incorporation of the results of the follow-up survey into the EIA report
- Close coordination with the JICA Study Team for the EIA study

4.2.3 Progress of EIA Procedures on Banchare Danda Landfill Site

According to the SWMRMC, the progress of the EIA on the Banchare Danda landfill site is shown below:

- Public notice: August 8, 2005
- Pasting of public notice in VDCs: August 8, 2005
- Submission of Scoping Report and TOR for EIA to Ministry of Environment, Science and Technology (MOEST): October 31, 2005
- Submission of a letter to Ministry of Forest and Soil Conservation (MOFSC) for the approval of forest/tree clearance by the Project: December 8, 2005
- Organization of Review Committee by MOEST: February 27, 2006
- Official approval from MOEST on Scoping Report and TOR for EIA: March 3, 2006
- Selection of a local consultant and conclusion of contract between SWMRMC and the selected local consultant: May 2006
- Commencement of EIA study by the selected local consultant: May 2006
- Submission of Inception Report on EIA by the selected local consultant: July 7, 2006
- Preparation of a cadastral map (as part of land acquisition): July 2006
- Un-official public consultations: June 2006 - to date

It was explained that a local consultant was selected and the contract between the SWMRMC and the selected local consultant was concluded in May 2006. The EIA study by the local consultant has started since the middle of May 2006. However, mainly because of the unstable social conditions around the site, the EIA study has been suspended frequently although unofficial consultation between the SWMRMC and local people has been conducted for contents of EIA as well as concept design of the site including extent of buffer area. According to the SWMRMC, the EIA study would be re-started soon. In this case, the final approval of the EIA report is expected to be issued by MOEST at the end of August 2007 as of March 12, 2007.

4.3 Results of Follow-up Survey for EIA on Banchare Danda Long-term Landfill Site

4.3.1 Topography Survey

The topography survey for a total area of approximately 65 ha was conducted at the Banchare Danda L/T-LF. The site is formed by the meandering river, the Kolpu Khola River, with a plateau in the middle in the north-south direction. There are two distinct ridges in the north-south directions along the east and west borders of the site, which may form the natural eastern and western boundaries of the site. However the site continues its ascension towards the north and up to the dirt east – west road, where the topography survey was terminated. South of the river the terrain is ascending southwards.

The highest point along the western ridge is approximately 102m high from the river edge and 135 m high along the eastern ridge. Slope inclinations are milder along the eastern slope.

4.3.2 Geological Survey and Soil Investigation

(1) Geology

1) Geological Component

The Banchare Danda L/T-LF is underlain mainly by meta-sandstone and schist belonging to Tistung Formation of the Kathmandu Complex. The ratio of meta-sandstone/schist is about 70/30 at riverbed of the Kolpu Khola, and the ratio of meta-sandstone decreases to the northern mountainous area. Thick blocks (less than 5 m) or lenses of quartzite and gneiss are intercalated by meta-sandstone or schist, and a fairly large dyke of pegmatite is found in the middle flank of the northern slope of the proposed landfill site. These intercalated thin layers are generally highly weathered and deteriorated.

Two small terraces of 3 m and 7 m in height above the riverbed and covered with thin deposits are on the center ridge of the site. Colluvium covering north-side and east-side slopes is less than one meter in general. Relatively thick, 3-5 m in parts, colluvium covers west-side hill area. Alluvium occurs along the recent river, less than four meters thick in general, while relatively extended deposits are present on the riverbed at the west side of the landfill site.

2) Structure

The strikes of the bedding planes of the site are basically extending E-W to ENE-WSW direction. The bedding plans of meta-sandstone and schist dip 80-90 degrees northward at the proposed waste storage dam side, whereas the dip is about 50 degrees north-westward at the north side slope of the proposed landfill site. An anticline structure is anticipated at the neck of the small ridge on which diversion facilities will lie.

3) Fault

No visible and continuous fractures are detected in proposed site except for small scale and minor discontinuities. An E-W trending fault separating the Tistung Formation of low-grade

metamorphic rocks from gneissic rocks (high-grade metamorphic rocks) is inferred to lie to the north of the landfill site.

(2) Engineering Assessment

1) Waste storage dam

a. Site Geology

The waste storage dam site is underlain by alternation of meta-sandstone and schist dipping about 80-90 degrees northward. Relatively thick colluvium of about four meters covers the right bank of the waste storage dam.

b. Expect Shear Strength

Expected shear strength of each rock class is as follows:

CM class : $\tau 0 =$ 10 kgf/cm2
CL class : $\tau 0 =$ 4 kgf/cm2

The above shear strength might be modified according to any new information following the geological investigations to be conducted during the detail design stage.

c. Foundation Treatment

An impermeable layer of the bedrock (permeability coefficient: about 1.0 x 10 -5 cm/s), occurs at the depth of about 10 m below riverbed. The geological structure of bedrocks parallel to the dam axis and dipping 80-90 degrees contributes conditions that are effective towards water shielding.

In addition, a downstream-ward shift of the dam axis on the right bank side is preferable for the dam foundation, since the right bank of the waste storage dam is covered by relatively thick colluvium and relatively permeable.

2) Landfill Area

a. Site Geology

The proposed landfill site lies on meta-sandstone and schist dipping northward steeply near the riverbed and relatively brittle biotite schist dipping 40-50 degrees north-westward dominates at the northern portion. A thin layer of highly weathered gneiss extends west-eastward at the west side saddle of the landfill site.

b. Leakage Risk of Polluted Water

There is no possibility of polluted water leakage from north and east side, because a permanent spring is observed at the flanks of the slopes and the ground water level will be higher than impoundment level of landfill site. However, leakage risk from the landfill site through the saddle of the west-side hill can not be denied due to a low groundwater level shown by the oxidized and unsaturated condition of drilling cores. Seepage control works

using impermeable clay etc. will be required at the saddle to prevent infiltration of polluted water from the landfill site and protect the environment.

c. Slope Stability

No large-scale landslides, which are harmful to waste landfill works, are detected in the landfill area.

3) Diversion

a. Site Geology

The site of the diversion facilities is underlain by meta-sandstone and schist rocks, whose fresh portions (CM class) are solid and suitable for the foundation of the diversion facilities.

b. Slope Stability

The recommended stable gradient for a cut slope based on the field geotechnical assessment and the experiences in Japan is:

D class	H:V=1.0:1.0
CL class	H:V=1.0:0.8
CM class	H:V=1.0:0.6

Above stable gradient might be revised based on observation on the cut slope.

4) Construction Materials

River deposits are suitable for concrete aggregates. Obtainable quantities are roughly estimated to be 20,000 m3 and river deposits alone will be insufficient in quantity for the material resources. Excavated materials during the construction are also utilizable, although yield loss will be high since relatively thin-bedded meta-sandstone dominated around the waste storage dam site. Soil materials to cover solid wastes will be obtained from the hill on the west side of the landfill site.

5) Access Road

Old landslide scars are distributed on the flank of the Kolpu Khola River immediately downstream of the Banchare Danda L/T-LF and some slopes are covered by loosened materials. The road excavation at the toe of the slope would trigger slope failures.

4.3.3 Hydrological Survey

The hydrological survey was conducted in order to gauge natural conditions in the surrounding area of the Banchare Danda landfill site, to assess potential impact to the surrounding lands before/after the river diversion, and to survey the river cross section for the floodwater level calculation. A field survey was conducted to record the current land and water use, for sampling riverbed materials and carrying out the river cross section survey. For collection of the meteorological data, a new observation station was established at the

Sisdol landfill site. The flood water level was computed by using HEC-RAS. The survey area was set at 1 km upstream and 5 km downstream from the Banchare Danda landfill site.

(1) Land Use and Water Use

Throughout the field survey, it was found that the land in the surrounding area of the Banchare Danda is mainly barren land or in use as paddy and cornfields. The survey found that the river water is not used for drinking purposes in spite of irrigation use for some land. As there are no wells, no use of groundwater was found in the survey area.

(2) Hydrological Condition

Daily maximum and minimum temperature, relative humidity and precipitation have been observed at the new observation station since July, 2006. River discharge has been measured once a week since February,2006 whereas the daily water level has been checked every day.

Table 4.3-1 Summary of Hydrological Condition

Mean Maximum Temperature	26.7 ^{0}C
Mean Minimum Temperature	21.8 ^{0}C
Monthly Total Rainfall	558.6 mm
Mean Monthly Relative Humidity	79 %
Mean Monthly Relative Humidity at 5.45 PM	76 %
Mean Daily Discharge (June ~ August)	0.95 m3/sec

Source: JICA Study Team

(3) Design Flood Discharge and Flood Water Level

The design flood of the river structures was decided at the 100-year return period flood in accordance with the design of the Sisdol landfill site. The design flood discharge was estimated at 350 m3/sec on the basis of the past annual maximum rainfall data in the surrounding meteorological stations. Water surface profile was computed employing HEC-RAS. The water level before/after the river diversion was calculated to be almost the same and lower than the surrounding ground level. Accordingly the flooding impact after the river diversion will be much the same as the present situation.

(4) River Bed Material

Riverbed material was taken at three sampling points and tested for the grain distribution. As a result of the test, the mean diameter of the riverbed material was estimated at 35 mm, which might be washed away by flood flow. Accordingly the riverbed protection is be recommended around the mouth of the river diversion channel.

4.3.4 Supplemental Environmental Survey

Water quality analysis was conducted sampling river water and groundwater twice in each dry season and rainy season. Water sampling was done at five sampling points, three in the river and two in the boreholes beside the river course. The sampling was done in February 2006 and March 2006 for the dry season sampling and July and August 2006 for the rainy season sampling. The results for the major parameters are shown in the following table.

Table 4.3-2 Results of Water Quality Analysis

Parameter	River		Groundwater	
	Dry	Rainy	Dry	Rainy
pH	8.5	8.4	7.7	7.4
Dissolved Oxygen (DO): mg/l	8.7	8.3	4.7	3.0
Total Dissolved Solids (TDS): mg/l	131	116	139	138
Total Suspended Solids (TSS): mg/l	327	81	1,859	2,073
Biochemical Oxygen Demand (BOD): mg/l	7.7	4.4	18.6	17.5
Chemical Oxygen Demand (COD) : mg/l	20.0	28.8	65.4	80.4
Iron as Fe mg/l	0.17	0.17	47.3	13.1
Manganese as Mn mg/l	0.05	0.05	1.39	0.69
Ammonia- Nitrogen (NH_4-N) mg/l	1.67	0.12	1.44	0.63
Fecal Coliform (MPN/100ml)	2,400	329	5,100	584

Source: JICA Study Team

4.3.5 Concept Design

(1) Basic Considerations for the Design

The basic considerations for the design are as follows:

1) For the sanitary landfill the semi-aerobic type shall be applied.
2) A horizontal liner shall be applied along the site bed and to a height of around 5 meters along the slopes.
3) In order to estimate the leachate quantity, the average rainfall data from the stations at both Kakani and Dhunibeshi shall be used.
4) Leachate treatment shall be by aeration and sedimentation ponds with re-circulation, and the ponds shall have sufficient capacity to limit discharge of the leachate to the adjacent river.
5) The waste storage dams shall be constructed by the soil-cement method.
6) Passive venting of the landfill gas shall be adopted in the concept design.
7) The access road under design by the SWMRMC should lead into the administration area proposed to be constructed on the western area of the site.

(2) Site Characteristics to be Considered in the Design

The characteristics of the Banchare Danda site were carefully studied and considered within the concept design. The main points considered were as follows:

1) Slopes

The slopes circling this site are steep, uneven and prone to landslides in some areas. Therefore no works are planned on the slope surface.

2) Reduction of leachate generation

This site has very high precipitation and measures for reduction of leachate are important; such as surface drainage of the slope by installing a rain water drain, and installation of a block embankment to divide the site into active and non-active disposal areas

3) Liner facility

Due to the nature of the slopes it was difficult to install the liner along the slopes, and therefore a horizontal liner was designed only on the bed.

4) Waste slippage

To reduce the risk of waste slippage into the adjacent river the waste slope is designed to be slight, and with limited heights.

(3) River Diversion

The river diversion channel was designed taking into consideration channel hydraulics in the vertical gap of 16 m, effective energy dissipation, slope stability along the proposed route and project cost. From an economic viewpoint it was decided upon the proposed route passing the saddle point of the central plateau.

The type of drop channel, which is the main part of the river diversion channel, was determined by comparing two different types, the cascade channel and chute channel. The result of the comparison is shown in the following table.

The construction cost of the cascade channel was considerably cheaper than that of the chute channel. But structural and environmental disadvantages of the cascade channel were more serious problems for sustainable operation. In the end, the chute channel was selected as the appropriate option for the river diversion scheme.

Table 4.3-3 Comparative Study of Drop Channel Type

Aspect	Cascade Type	Chute Type
1.Technical	***Advantage:*** i) Effective energy dissipation against operating head more than 15m ensures. ii) Design is relatively easy, compared to others. iii) Lesser basin length and protection works can be requested. ***Disadvantage:*** i) Scouring of bed in the apron is bigger than chute type. ii) Low height of cascade cannot be adopted in the current site space.	***Advantage:*** i) Effective energy dissipation against operating head more than 15m ensures a hydraulic jump in the stilling basin. ii) Prospective risk of scouring in the channel bed is less than cascade type. ***Disadvantage:*** i) Channel length becomes longer than cascade type.
2.Environment	i) Serious damage for floating life in the river due to the higher drop. ii) Excavation volume becomes more than chute type.	i) From the landscape viewpoint, chute is more suitable than cascade. ii) Excavation volume becomes less than cascade type.
3.Economic	NRs. 39,450,000	NRs. 62,590,000

Source: JICA Study Team

(4) Design Capacity

The Banchare Danda L/T-LF will function to dispose of the municipal wastes collected from KMC, LSMC and KRM. Starting from the year 2009, the accumulated volume of disposed waste from the three municipalities plus the volume of materials for soil cover is estimated to be 3.7 million m^3 in 2027 and 4.03 million m^3 in 2028. The volume available for disposal is calculated to be 3.96 million m^3. Accordingly the Banchare Danda L/T-LF is expected to have a life span of between 19 and 20 years.

(5) Leachate Quantity Estimates

1) Calculation method

The quantity of leachate has been calculated using a rational formula. The calculation period duration was fixed at 30 years (20 years for landfill operation and 10 years for operation and maintenance).

2) Daily rainfall

The nearest stations were in Kakani (elevation 2,064m, distance 5km) and Dhunibeshi (elevation 1,085m, distance 6.5km). The elevation at the project site is 1,100m, which is similar to Dhunibeshi station, but it is closer to Kakani. Therefore average rainfall data from both stations were used in the estimation.

3) Target area

The target area has been fixed at the level where the area is the largest. In order to reduce leachate production the area is divided into four (4) sections, as shown in Figure 4.3-1.

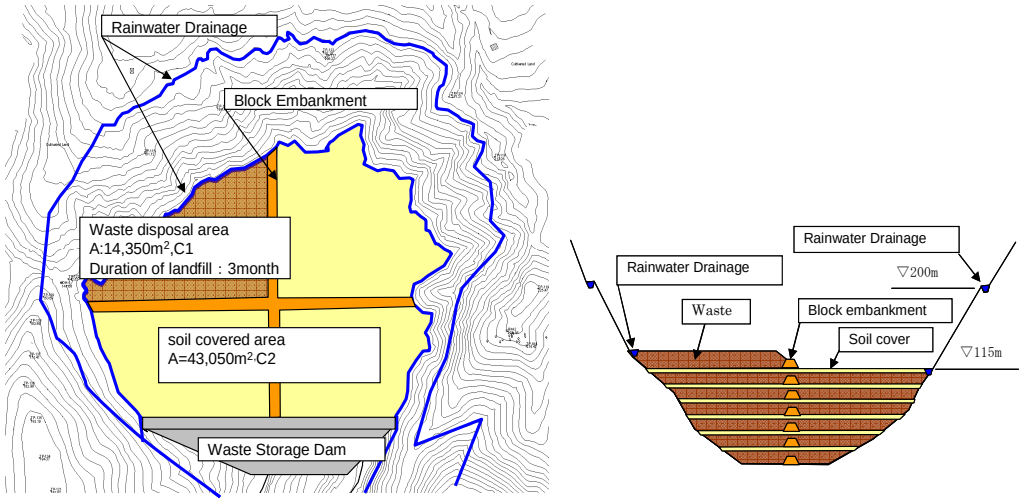


Figure 4.3-1 Plan and Section of Landfill at 110m level

4) Amount of evaporation

The amount of evaporation resulting from re-circulation of the leachate back into the landfill site is estimated as 10% and 20% of the re-circulated leachate amounts in the wet season and dry season respectively.

5) Estimation result

The results show that an aeration pond and sedimentation pond with a combined capacity of 60,000 m^3 will be sufficient to ensure that the amount from 30 years of leachate generation, after losses by evaporation, can be secured within the site and there should be no reason for discharge into the adjacent river.

(6) Facilities Plan with Phased Development

The landfill should be developed in two phases. In Phase 1, there are two stages, and the waste disposal operations will start upon completion of Phase 1 - Stage 1. The facilities to be provided may be broadly categorized into main, administrative and secondary facilities. Figure 4.3-2 shows the layouts for the landfill before commencement of the waste disposal operation in Phase 1. A description of the facilities and their respective functions is given in Table 4.3-4.

Table 4.3-4 Functions and Structural Description of the Landfill Facilities

Items	Function	Structure
Main Facilities		
1.Waste storage facility		
Waste storage dam	To prevent the waste out-flowing from the landfill site	Materials for dam construction shall be excavated soil (gravel and soil) mixed with cement.
Block Embankment	Block embankment along the center of for leachate reduction, and efficient landfill operation.	Construction of embankment with soil.
Saddle dam	The saddle dam will be constructed at along the western border of the landfill, to prevent waste spillage.	Materials for dam construction shall be excavated soil (gravel and soil) mixed with cement.
2.Liner facility	Impermeable facility within the landfill for preventing leachate from infiltrating into ground. In this concept design the horizontal liner was adopted, however it is recommended to continue study of vertical liner applicability based on a detailed soil and hydro-geological investigation.	Horizontal liner From the ground upwards; (1) compacted clay liner (t=50cm, permeability coefficient<10^{-6}cm/s), (2) Geotextile layer (t=10mm), (3) Geo-membrane liner (t=1.5mm), (4) Geotextile layer (t=10mm), and (5) protection layer of clay soil (t=50cm)
3.Rainwater drainage facility	To drain the rainwater running off the slope of the landfill site and prevent rainwater collected having access the waste areas.	U-shaped gutter of bottom width 300mm x depth 600-700mm in the trench
4.Leachate collection	The leachate collection system facility, installed above the liner, in combination with the landfill gas collection vents will serve to convey air into the waste layers to enhance semi-aerobic conditions.	Main pipe: Installation of perforated RC pipes of dia. 1000 mm surrounded by gravel. Branch pipe: Installation of perforated RC pipes of dia. 400mm surrounded by gravel.
5.Leachate treatment	This facility will treat/ purify leachate to mitigate impact on the surrounding environment by aeration and sedimentation treatment.	The capacity of aeration pond is 20,000m^3 and sedimentation pond 40,000m^3. Eight blowers (7.5kW per unit) shall be set up in the Aeration pond.
6.Leachate Re-circulation facility	This facility will re-circulate leachate back to the disposal site, contributing to reduction of the leachate amount, and providing further treatment.	Installation of re-circulation pump of capacity 15KW, sprinkler and portable flexible hose pipes (80mm dia).
7.Gas collection facility	In order to prevent fire and/ or explosion hazards, impact on ecological system, and offensive odor to surrounding areas caused by produced gases; gas removal facilities shall be installed.	Install perforated RC pipes of dia. 300mm vertically at 20m spacing and surrounded by stone boulders inserted within encircled wire mesh to heights of 2.5m.

Items	Function	Structure
Administrative Facilities		
1.Administration building	An office building for the site staff, including space for visitors.	Two-story RC and Brick structure with area of approx. 200m^2
2.Operation road	Roads are built from the administration area to the landfill site	Construction of concrete paved roads with 5m widths
3.Weighbridge	Measures the hauled in waste to control the landfill volume.	The specification for max. capacity of 30 tons. The foundation has concrete pits.
4.Vehicle Wash Facility	A facility for washing the tires of waste trucks before they exit the site.	Installation of car wash pool and High-pressure washing machine in two sets.
Related Facilities		
1.Enclosure facility	Enclosure facility is built along the boundary of landfill site premises and the outer circumference of the landfill to provide access control.	Chain Link fencing of 800 mm high over 1200 mm high brick wall. Gates at the site entrance

Source: JICA Study Team

(7) Landfill Operation and Maintenance Guidelines

The operation and maintenance is important in order to manage the final disposal site appropriately and decrease the required O&M efforts during the post-closure management (PCM) stage.

1) O&M Activities

The following O& M activities are necessary:

- Collection vehicles control
- Departing vehicles control
- Facilities maintenance operation
- Landfill operation management
- Environmental monitoring

2) Operation day and time

- Daily Operation hours: 6:30 to 15:00
- Saturday and National holidays: 6:30 to 13:00

3) Collection vehicles control

The measurement of the waste and the cover soil shall be implemented using the weighbridge.

4) Departing vehicles control

It is necessary to wash the vehicle tires in the car washing facilities before their departure.

5) Facilities maintenance management

For appropriate management of the individual facilities, each shall be checked daily when abnormality is found and necessary action shall be immediately taken.

6) Landfill operation management

Along with securing the quantity of disposed waste, and from the view point of the rapid stabilization of the landfilled waste, as well as improving the quality of leachate and gas generated, proper operation should be enforced.

a. Operation procedure

Wastes coming to the landfill site shall be measured and checked. Afterward, wastes are unloaded, spread and compacted with bulldozer to a certain thickness. Wastes are covered with daily soil at the end of operating hours.

This daily operation will continue to form the prescribed landfill shape.

b. Landfill operation plan

① Landfill Operation

Landfill method: Cell method is applied. In this method, wastes will be covered with soil at the end of daily operating hours, to form a waste disposal cell. The height of cell should be 2-3 m.

② Cover soil

Covering will be carried out as follows;

- Daily cover: minimum 10 cm.
- Intermediate cover: minimum 50 cm
- Final cover: minimum 150 cm

③ Landfill plan

A block embankment will be provided along the center of the disposal area for leachate reduction, and efficient landfill operation.

(8) Operation and Maintenance Structure

Table 4.3-5 shows the proposed staff and their respective duties while the second part of the table describes the heavy equipment requirements.

Table 4.3-5 Landfill Staff and Heavy Equipment

Item		No.	Duty/ Function
A. Landfill O&M Staff			
1)	Manager/ Engineer	1	Overall site operation management
2)	Engineer	2	Plan daily operations, maintain records, analyze data
3)	Clerk/ Secretary	1	Manage petty cash, maintain site operation records, spare parts inventories, etc.
4)	Weighbridge operator	1 (2)	Operate weighbridge facility and keep records of incoming wastes
5)	Heavy equipment operators	8 (9)	Operate heavy equipment used at the site and area from where materials for soil cover are taken.
6)	Mechanic	2	Maintain and repair landfill equipment and heavy equipment
7)	Workers	4	Undertake miscellaneous works in connection with the operations
8)	Truck drivers	2	Drive the soil trucks and maintenance pick-up
9)	Guards	2	Maintain site security
Total STAFF		23 (25)	
B. Heavy Equipments			
1)	Bulldozer	1 (2)	Description: 220 HP, 24t, track height 550mm Function: Waste spreading and compacting
2)	Compactor	1	Description: 35t Function: Waste spreading and compacting
3)	Wheel loader	1	Description: 3.5m^3, 200-230 HP, 18t Function: Transport soil cover materials from the source area of the soil materials to the truck
4)	Excavator	2	Description: 0.8m^3, 18t, 125-130 HP Function: Excavate in soil and waste to clear ditches, prepare cells, and dig materials for cover
5)	Dump truck	2	Description: 10t class Function: Transport materials for soil cover, other functions such as equipment and labor transport, etc.
6)	Water tanker	1	Sprinkle water on the waste as countermeasure against scattering, road maintenance, and fire prevention

Note: Figures in brackets indicate value after year 2019
Source: JICA Study Team

(9) Environment Monitoring

The environmental monitoring is as follows:

a. Water quality monitoring (inspection) of groundwater

b. Water quality monitoring (inspection) of generated and treated leachate

c. Monitoring (Inspection) of generated gas

d. Offensive odor prevention

e. Sanitary insect prevention

(10) Project Implementation Schedule

The project implementation schedule may be broadly divided into Pre-Construction Works and Construction. The Construction period is further divided into Phase 1 – Stage 1, Phase 1 – Stage 2 and Phase 2. The project implementation schedule is shown in Table 4.3-6. The construction works are divided into two phases with the bulk of the works implemented during Phase 1 – Stage 1. The total construction period is estimated to be 20 months, including the monsoon months when construction is not expected to progress.

Heavy and light equipment needs to be procured and installed at the site, as required by the time of waste disposal operations at the completion of Phase 1 – Stage 1. Most of the equipment will need to be imported and the duration set for this procurement, training on the equipment and handing over is set at 10 months from the date of signing of the construction contract.

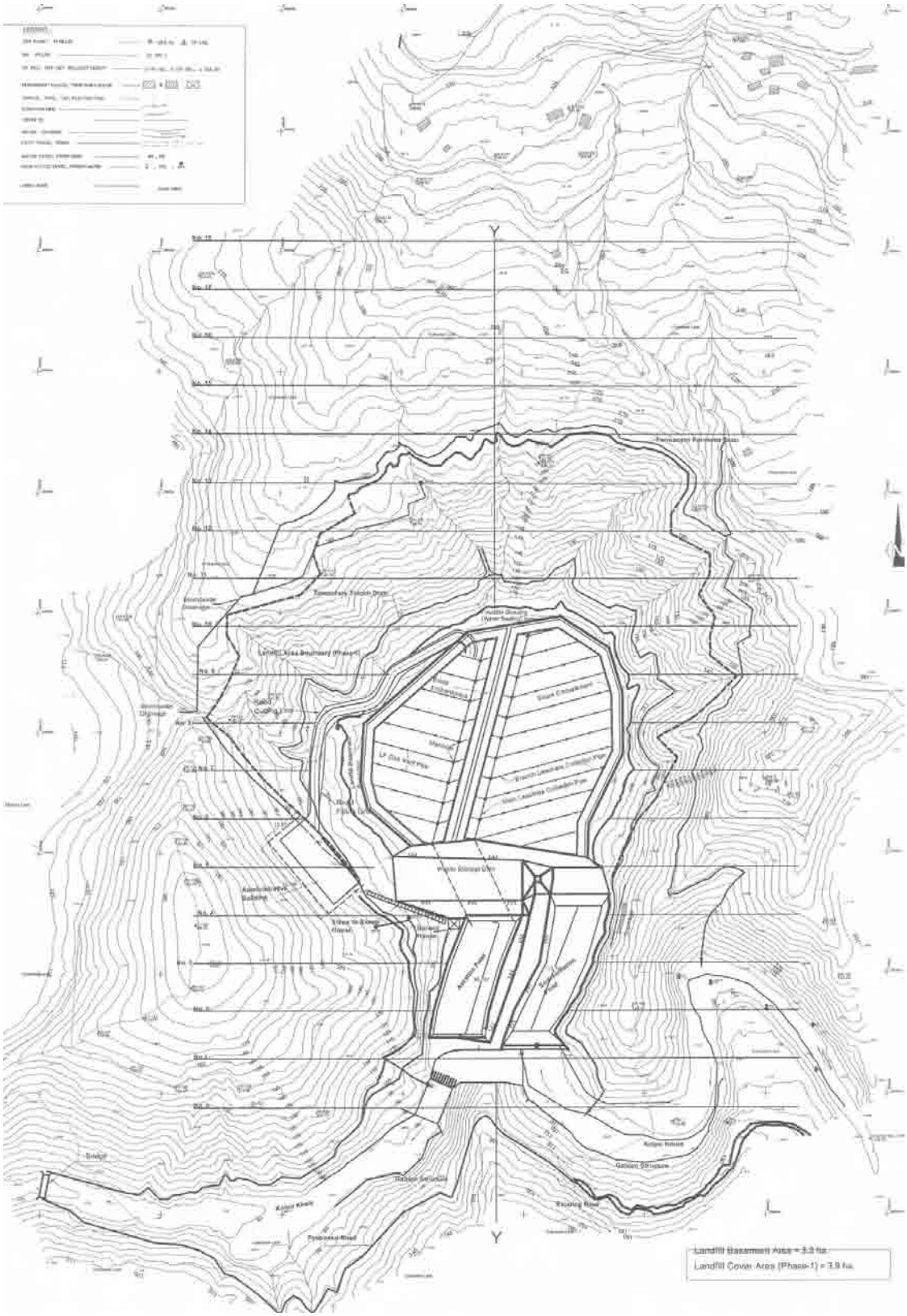
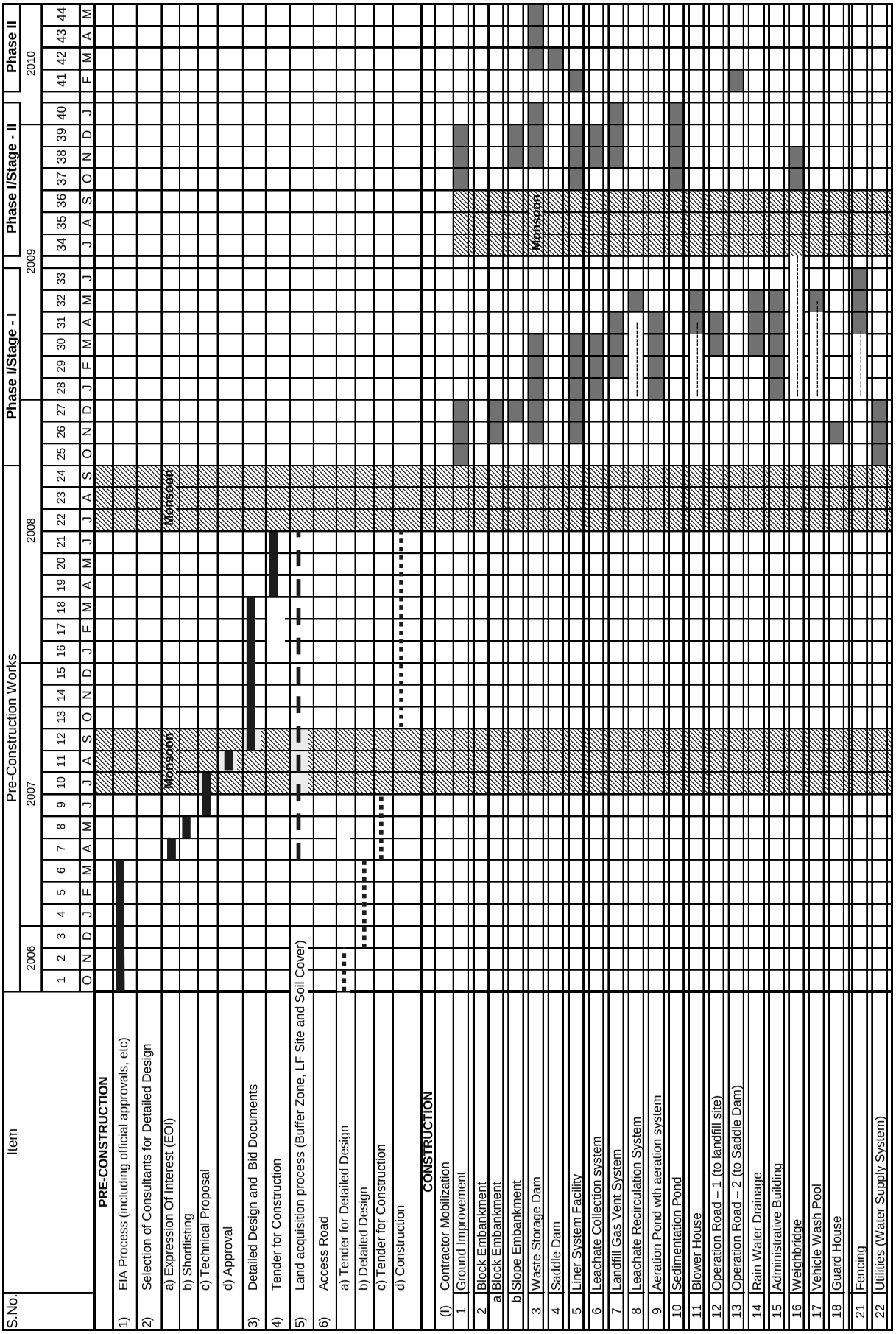


Figure 4-3-2 Facilities Layout Plan in Phase I

Table 4.3-6 Project Implementation Schedule



4.3.6 Financial Plan

(1) Overall Cost of Banchare Danda LF

The overall cost of the Banchare Danda L/T-LF site is estimated at Rs. 2,588.3 million in total over the period of 32 years from FY2007/08 until FY2038/39 as shown in Table 4.3-7.

Table 4.3-7 Overall Cost

Cost Component		Million Rs.	Remarks
1) Development		1,677.5	Phase-1 and Phase -2
2) Procurement of Equipment	Initial	106.4	Procurement in FY 2009/10
	Renewal	143.2	Procurement for replacement afterwards
	Total	249.6	
3) O&M		613.6	Total of 20 years from 2009/10 until 2028/29
4) Post-closure Maintenance		47.6	Total of 10 years from 2029/30 until 2038/39
Total		**2,588.3**	

Source: JICA Study Team

(2) Cost Sharing

The criteria for a cost sharing concept for Banchare Danda LF between Government and municipalities are proposed, and as a result the cost to be carried respectively by both sides is presented in Table 4.3-8.

Table 4.3-8 Cost Sharing between Government and Municipality

Component	SWMRMC			Municipalities	
	Concept	million Rs	External Sources	Concept	million Rs
Land acquisition	Full	11.2	-	-	-
Development Phase 1	Full	1,337.5	Expected	-	-
Development Phase 2	Full	328.8	-	-	-
Heavy Equipment (Initial)	Full	106.4	Expected	-	-
Renewal of Equipment	-	-	-	Full	143.2
O&M	-	-	-	Full	613.6
Post-closure Maintenance	Full	47.6	-	-	-
Total	-	**1,831.5**	-	-	**756.8**

Note: Full – full share, and Expected –financial support be expected

Source: JICA Study Team

It is proposed that the costs generated by joint work should be shared among the municipalities concerned on the basis of the amount of solid waste transported from the municipalities to the site as shown in Table 4.3-9.

Table 4.3-9 Cost Sharing among Municipalities (million Rs)

Municipality	Cost Items	1st Decade	2nd Decade	Total		Own
		09/10-18/19	19/20-28/29	09/10-28/29	Average	Revenue
KMC	O&M	233.7	313.4	547.1		
	Renewal of Equipment	128.0	0.2	128.2		
	Total	361.7	313.6	675.3	33.8	742.2
	(% of Own Revenue)				**(4.6%)**	
LSMC	O&M	27.2	32.2	59.4		
	Renewal of Equipment	13.2	0.1	13.3		
	Total	40.4	32.3	72.7	3.6	133.3
	(% of Own Revenue)				**(2.7%)**	
KRM	O&M	2.9	4.2	7.1		
	Renewal of Equipment	1.7	-	1.7		
	Total	4.6	4.2	8.8	0.4	20.7
	(% of Own Revenue)				**(1.9%)**	
Total		406.7	350.1	756.8	37.8	896.2
	(% of Own Revenue)				**(4.2%)**	

Note: Own revenue; average of own revenue during 10 years from FY2005/06 till 2014/15 estimated by JICA Study Team
Source: JICA Study Team

(3) Financial Analysis on Overall SWM Operation over the period of 10 years from 2005/06 until 2014/15

The "cost-to-revenue ratio (that is; overall SWM costs divided by overall own revenues)" of the three municipalities can be calculated respectively at 16.6% for KMC, 26.6% for LSMC, and 9.5% for KRM on average over 10 years. Accordingly, the "cost-to-revenue ratio" of the three municipalities can be judged to be moderate or rather low because it is said that the "cost-to-revenue ratio" of the municipalities in the developing countries generally ranges between 20% and 50%.

Table 4.3-10 SWM Costs and Own Revenues (million Rs)

Items	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	Total
	62/63	63/64	64/65	65/66	66/67	67/68	68/69	69/70	70/71	71/72	
	Sisdol and Other LF				Banchare Danda LF						
1. KMC											
Overall SWM Costs (A)	111.1	144.6	97.5	111.0	156.6	118.7	121.3	131.5	120.6	116.6	**1,229.4**
Overall Own Revenues (B)	650.8	686.4	724.2	752.5	784.1	785.6	775.2	764.8	754.2	743.8	**7,421.6**
Ratio (=A/B)	17.1%	21.1%	13.5%	14.8%	20.0%	15.1%	15.6%	17.2%	16.0%	15.7%	**16.6%**
2. LSMC											
Overall SWM Costs (A)	16.2	40.3	29.8	36.0	36.5	36.3	36.4	44.1	38.0	40.5	**354.0**
Overall Own Revenues (B)	117.2	124.0	131.3	136.5	142.3	142.1	139.2	136.4	133.3	130.5	**1,332.8**
Ratio (=A/B)	13.8%	32.5%	22.7%	26.4%	25.7%	25.5%	26.1%	32.3%	28.5%	31.0%	**26.6%**
3. KRM											
Overall SWM Costs (A)	1.0	3.1	1.2	1.8	1.7	2.1	1.8	2.8	1.9	2.2	**19.7**
Overall Own Revenues (B)	20.1	20.9	21.7	22	22.2	22	21	20	19.1	18.1	**207.1**
Ratio (=A/B)	5.0%	14.8%	5.5%	8.2%	7.7%	9.5%	8.6%	14.0%	9.9%	12.2%	**9.5%**

Source: JICA Study Team

4.4. Follow-up Survey for Other Facility Development

The follow-up survey for other facility development was conducted for the development or temporary use of Balaju and Afadole transfer stations, as follows:

- Field reconnaissance of the areas surrounding both sites depicting baseline environmental conditions including land use in the areas surrounding the sites.
- Identification of future environmental and social issues that may result from the operation of transfer stations and recommend mitigation measures
- Implementation of concept design
- Recommend further studies for the IEE including environmental management and monitoring programs in the case of developing the two sites as permanent transfer stations.

4.4.1 Results of the Follow-up Survey for Balaju Transfer Station

(1) Environmental Conditions

The planned transfer station at Balaju is located along the right bank of the Bishnumati River. The site area is rectangular in shape elongated north-east to south-west direction (around 240 m) having an average width of around 27 meters, and an area of around 0.8 ha. It was originally planned for the site to be developed as a transfer station under the Kathmandu Valley Mapping Project during 1994 - 1995. Only a boundary wall was constructed and transfer operation was not conducted.

The narrow earthen road has been widened to 11 meters and the boundary wall has been dismantled and barbed wire fencing installed. A second earthen road has also been developed downstream of the site perpendicular to the existing road leading to the ring road at the north.

The site topography in general is flat while a strip of around 12 meters along the riverbank bears low land. The site area contains an open grass field. A ruined masonry toilet and a shed are located at the north-east corner of the site.

The land use pattern near to and surrounding the site is, in general, residential settlement with a community organization and a church located just besides the site. Around 75 and 170 households were noted on the left and right banks of the Bishnumati River, respectively. Eleven (11) small-scale factories and workshops surround the area.

(2) Concept Design of Balaju Transfer Station

1) Alternatives Development

Considering space limitations, environmental concerns and costs; five alternatives were formulated, as described in Table 4.4-1.

Table 4.4-1 Balaju Transfer Station Alternatives

Alt.	Unloading Platform		Tipping Area	Remark
	Platform height	Reloading stations		
1	GL+3.45m – Loading to container mounted on truck	2 stations x 3 bays	Small	Handling Capacity: Highest Cost: High Environment: Mitigation of waste storage at site
2	GL+3.45m – Loading to container mounted on truck	1 station x 3 bays	Medium	Handling Capacity: Medium Cost: High (not much saving compared to Alt. 1) Environment: Some delay in waste transport from station may occur
3	GL+2.0m – Loading to detached container	1 station x 3 bays	Medium	Handling Capacity: Medium to low Cost: Medium (slightly more saving compared to Alt. 2) Environment: More delay in waste transport from station may occur Some noise and other concerns due to container mounting – detachment operations at the station
4	GL+1.72m, GL-1.72m – Depressed bay for transfer trucks – Loading to container mounted on truck	1 station x 3 bays	Medium	Handling Capacity: Medium Cost: Medium to low (savings in fill works with expenses in drainage works at depressed bays) Environment: Some delay in waste transport from station may occur Lower platform height improves visual aspect. Drainage system of depressed bay potential pollution hazard to river
5	None	None	Large	Handling Capacity: Lowest Cost: Lowest (however wheel loader(s) need to be procured) Environment: Fear of waste storage at site Odor and insects generation fear.

Source: JICA Study Team

In terms of cost, Alternative 5 is the least expensive one; however there are environmental concerns that may arise if the station is not operated very efficiently with the waste speedily removed. On the other hand, Alternative 1 offers the best waste handling capacity at the highest cost.

2) Salient Features of Balaju Transfer Station

A summary of the salient features for both Alternatives 1 and 5 are given in Table 4.4-2.

Table 4.4-2 Salient Features of Balaju Transfer Station

No.	Item	Description	
		Alternative 1	**Alternative 5**
1	Project Name	Balaju Transfer Station	
2	Location	Ward 16, Balaju, KMC	
3	Type	Open Top, Direct Loading including Tipping Area	Storage load system with tipping area only
4	Area	0.8 ha	
5	Daily waste arrival	75 t/d (assumed for design)	
6	Peak hour waste	18.75 t/hr	
7	Transfer truck capacity	15 m^3 (size 8m x 2.5m x 2.8m)	
8	Collection truck capacity	Average 6m^3 (size 6m x 2.5 m)	
9	Unloading platform	33m x 14.5m raised 3.45m above GL (Embanked with stone masonry retaining wall along both sides, i.e. reloading station and boundary to existing road, R.C.C. paved surface with nominal reinforcement). 0.25m R.C.C. guide wall of height 0.25m along three sides with extension of boundary wall along road side. 0.50m space left along the edge of embankment where there is no wall.	None
10	Reloading stations	Two at design ground level.	None
11	Approach and exit ramps	Length along centre line 33m. Embanked with stone masonry retaining wall on outer edge along transfer road side. Total width 5.0m, carriageway width 4m, 0.25m R.C.C. guide wall at both sides with 0.25m high, and remaining 0.5m space left along the edge of embankment where there is no wall.	None
12	Weighbridge	Space provision of 17.85 x 4.30 for weighbridge having weighing platform, approach and exit ramp.	
13	Scale house	Space provision of 4.5m x 2.5m.	
14	Tipping Area	698 m^2 RCC paved surface with nominal reinforcement.	1,600 m^2 RCC paved surface with nominal reinforcement. Total 15 tipping bays (6m x 4m per bay) provided
15	Administration Building	Three rooms with one bathroom/toilet covering 64 m^2.	
16	Guardhouse	Existing guardhouse to be renovated covering 15 m^2.	
17	Public bathroom/ toilets	Existing bathroom/ toilet to be renovated covering 7.5 m^2.	
18	Drains	One drain Type E is proposed. Rectangular open stone masonry catch drain draining entire transfer station surface runoff to waste collection tank of size 3.5m x 3.5m x 3.0m.	
19	Well and overhead tank	Provision of well and overhead tank kept at the corner of tipping area for vehicle washing purpose.	
20	Parking area	Parking adequacy for 4 vehicles allocating space of 8m x 3m for	Parking adequacy for 8 vehicles allocating space of 8m x 3m for

No.	Item	Description	
		Alternative 1	**Alternative 5**
		one vehicle. R.C.C. paved surface with nominal reinforcement.	one vehicle. R.C.C. paved surface with nominal reinforcement.
21	Traffic Circulation Route	All traffic circulation routes within the transfer station R.C.C. paved with nominal reinforcement.	
22	Buffer zone	Boundary wall with net fencing along the roadside and riverbank protection wall with net fencing along the riverbank.	

Source: JICA Study Team

3) Proposed Facilities

The facilities described in Table 4.4-3 have been incorporated in the concept design.

Table 4.4-3 Facilities of Balaju Transfer Station

No.	Facility	Comment
1	Administration Building (3 rooms & Bathroom)	
2	Guard House	Renovate existing structure
3	Weighbridge	Space provision*[1]
4	Work shop	Space provision, only small facility for tire repairs
5	Water well and tank	Space provision, with consideration on water supply system to be provided
6	Vehicle washing	Space provision
7	Lights	For office and working area
8	Embanked unloading and reloading platform	(Not included in Alt. 5)
9	Embanked ramps	(Not included in Alt. 5)
10	Paved waste tipping area	
11	Paved parking area	For 4 vehicles
12	Buffer	Boundary wall with appropriate fencing
13	River bank protection	Masonry wall
14	Paved traffic circulation route within station	
15	Drainage system for storm water and waste water	
16	Extension of existing RCC sewer pipe of dia. 60 cm for proper outfall to the Bishnumati River.	Extension length around 29m.
17	Leachate storage	Collection drains and storage tank

Note: *1) Space provision indicates that the facility will not be included in the concept design at this time
Source: JICA Study Team

(3) Suggestions for Balaju Transfer Station

1) Suggestions on the Environmental and Social Considerations

In the case of developing the site as a permanent transfer station, the screening to determine the level of environmental assessment (EIA or IEE) should be conducted as per the scale and activities in accordance to EPR Rule 3, Schedule 1 and 2. As the area coverage of the Balaju Transfer Station is planned to be 0,8 ha (less than 3 ha threshold value for IEE), the IEE including environmental management and monitoring programs should be conducted. Referring to schedule 1 and 2 of EPR, the above condition requires IEEn and its approval from the concerned Ministry (Ministry of Local Development).

The following are suggested key points to be considered by the proponent from the environmental and social viewpoints when the IEE study is conducted:

- The traffic circulation route for entry of loaded collection vehicles and empty transfer vehicles is planned via a newly developed earthen approach road from the ring road. Similarly, the exit route for empty collection vehicles and loaded transfer vehicles is planned via using the widened earthen road that leads to Balaju crossing. Detail traffic surveys and further studies should be implemented to confirm the acceptability of using these approaches.
- As Balaju transfer station is located within the residential settlement, it is anticipated that there will probably be social conflict due to its location. A brief and thorough formal consultation should be conducted with the local residents while addressing pertinent social issues and prescribing appropriate mitigation measures.
- Environmental pollution, especially that affecting water quality and producing odor, should be reduced as much as possible through mitigation measures. It is also essential that environmental monitoring be incorporated into the project's design and implementation.
- Outside workforce conflict (influx of waste pickers) needs to be carefully considered. Despite the restriction, waste pickers are anticipated to approach to the newly developed transfer station.
- A thorough study is required for identification of all parties, likely to be involved in the development and operation of the transfer station, with specific environmental responsibilities for effective implementation of mitigation measures and monitoring requirements during design, construction and operation phases of the project.

2) Technical Aspects

- KMC will require a transfer station to be located in the north of the city and Balaju T/S should be developed for this purpose in the absence of any other alternative site.
- The site location is satisfactory and the access to the ring road is being developed. However the road adjacent to the site needs to be upgraded and paved.
- Direct loading with a tipping area offers the best development alternative for the new transfer station but to meet the high cost for development KMC may need to develop the station over a longer period in phases.
- Accordingly development may start with the tipping area provided that most of the waste collected in the northern area is done using non-tipping collection vehicles.

4.4.2 Results of the Follow-up Survey for Afadole Temporary Transfer Station

(1) Environmental Conditions

The planned site at Afadole, Ward 4 in LSMC, is located along the left bank of the Bagmati River besides an earlier constructed oxidation pond that is not functioning. The site is located comparatively far away from residential settlement. The site contains an open grass field resting over waste filled materials.

Since the riverbank along the other side (west to the site) has been transformed into a dumping site for municipal waste, there is noticeable odor, litter and exposure of solid waste to the environment together with pollution of the Bagmati River.

The site and its surrounding area within a radius of 150-200 meters does not contain any notable settlements and is open riverside barren land owned by the Government. A temporary mud-built hut having CGI sheet roofing for the purpose of running a tea stall is located near the site besides the earthen approach road. A small open Mahadevi temple (without roof cover) is located besides the earthen approach road north to the site. The temple is frequently used for worship by nearby settlements.

(2) Concept Design of Afadole Temporary Transfer Station

1) Alternatives Development

Considering location aspects within the site, environmental concerns and costs; four alternatives were formulated, as described in Table 4.4-4. Alternative 1 offers the best handling capacity and lesser environmental concerns.

Table 4.4-4 Afadole Transfer Station Alternatives

Alt.	Unloading Platform		Platform location	Remark
	Platform height	Reloading stations		
1	GL+3.45m – Loading to container mounted on truck	2 stations x 3 bays	Center	Handling Capacity: High Cost: High Environment: Mitigation of waste storage at site and smooth traffic flow within the site
2	GL+3.45m – Loading to container mounted on truck	2 stations x 3 bays	South-east corner	Handling Capacity: High Cost: High Environment: Mitigation of waste storage at site but problem of traffic flow within the site
3	GL+3.45m – Loading to container mounted on truck	1 station x 3 bays	Center	Handling Capacity: Medium Cost: Medium (slightly more saving compared to Alternatives 1 and 2) Environment: Some delay in waste transport from station may occur
4	GL+2.00m – Loading to container detached from truck	1 station x 3 bays	Center	Handling Capacity: Medium to low Cost: Least costly Environment: Some delay in waste transport from station may occur Some noise and other concerns due to container mounting – detachment operations at the station

Source: JICA Study Team

2) Salient Features of Afadole Temporary Transfer Station

A summary of the salient features of the site is given in Table 4.4-5.

Table 4.4-5 Salient Features of Afadole Temporary Transfer Station

No.	Item	Description
1	Project Name	Afadole Temporary Transfer Station
2	Location	Ward 4, Afadole, LSMC
3	Type	Open Top, Direct Loading including Tipping Area
4	Area	1.4 ha
5	Daily waste arrival	75 t/d (assumed for design)
6	Peak hour waste	18.75 t/hr
7	Transfer truck capacity	15 m^3 (size 8m x 2.5m x 2.8m)
8	Collection truck capacity	Average 6m^3 (size 6m x 2.5 m)
9	Unloading platform	48.214m x 14.5m raised 3.45m above GL (Embanked with stone masonry retaining wall along reloading station, R.C.C. paved surface with nominal reinforcement). 0.25m R.C.C. guide wall of height 0.25m all around. 0.50m space left along the edge of embankment where there is no wall.
10	Reloading stations	Two at design ground level.
11	Approach and exit ramps	Length along centre line 28m. Embanked with stone masonry retaining wall on inner side along transfer vehicle traffic circulation route. Total width 5.0m, carriageway width 4m, 0.25m R.C.C. guide wall at both sides with 0.25m high, and remaining 0.5m space left along the edge of embankment where there is no wall.
12	Weighbridge	Space provision of 17.85 x 4.30 for weighbridge having weighing platform, approach and exit ramp.
13	Scale house	Space provision of 4.5m x 2.5m.
14	Tipping Area	2667 m^2 RCC paved surface with nominal reinforcement.
15	Administration Building	Three rooms with one bathroom/toilet covering 64 m^2.
16	Guardhouse	One room with one bathroom/toilet covering 18.80 m^2.
17	Public bathroom/ toilets	Four toilets with two bathrooms covering 39.12 m^2.
18	Drains	Total four types of drain proposed. Type A is rectangular stone masonry drain with R.C.C. slab covers. Type B is rectangular masonry open drain. Type C is masonry trapezoidal catch drain draining entire transfer station surface runoff to waste collection tank of size 3.5m x 3.5m x 3.0m. Type D is earthen trapezoidal roadside drain for approach road outside the transfer station.
19	Landfill gas collection pipes	100mm dia perforated PVC horizontal pipe laid underneath the drainage line covered by stone filled box extending to width of drain and 1.0m below drainage invert level. Vertical legs are to be kept at appropriate locations to vent out the gas.
20	Well and overhead tank	Provision of well and overhead tank kept at the corner of parking area for vehicle washing purposes.
21	Parking area	Parking adequacy for 31 vehicles allocating space of 8m x 3m for one vehicle. R.C.C. paved surface with nominal reinforcement.
22	Traffic Circulation Route	All traffic circulation routes within the transfer station R.C.C. paved with nominal reinforcement.
23	Buffer zone	6.2 m vegetative buffer zone all around, barbed wire fence on three sides and boundary wall with net fencing along approach road at eastern side.

Source: JICA Study Team

3) Proposed Facilities

The facilities described in Table 4.4-6 have been incorporated in the concept design.

Table 4.4-6 Facilities of Afadole Temporary Transfer Station

No.	Facility	Comment
1	Administration Building (3 rooms & Bathroom)	
2	Guard House	1 room with toilet
3	Weighbridge	Space provision(1
4	Work shop	Space provision
5	Water well and tank	Space provision, with consideration on water supply system to be provided
6	Vehicle washing	Space provision
7	Lights	For office and night work
8	Embanked unloading and reloading platform	
9	Embanked ramps	
10	Paved waste tipping area	
11	Paved parking area	For 30 vehicles
12	Buffer	Vegetative buffer with barbed wire fence
13	River bank protection	Gabion protection wall
14	Paved traffic circulation route within station	
15	Drainage system for storm water and waste water	
16	Leachate storage	Collection drains and storage tank
17	Scavengers working space	Required for around 50 scavengers
18	Toilets for scavengers	
19	Space for recovered materials	
20	Underground gas collection and venting system	

Note: Space provision indicates that the facility will not be included in the concept design at this time

Source: JICA Study Team

(3) Suggestions from the JICA Study Team for Afadole Transfer Station

1) Suggestions on the Environmental and Social Considerations

Same as the Balaju transfer station, the screening to determine the level of environmental assessment (EIA or IEE) should be conducted as per the scale and activities in accordance to EPR Rule 3, Schedule 1 and 2. As the area coverage of the Afadole transfer station is planned to be 1.4 ha (less than 3 ha threshold value for IEE), the IEE including environmental management and monitoring programs should be conducted. Referring to schedule 1 and 2 of EPR, the above condition requires IEE and its approval from the concerned Ministry (Ministry of Local Development).

The following are suggested key points to be considered by the proponent from the environmental and social viewpoints when the IEE study is conducted:

- As the site is located at the riverbank, the designed ground level of the transfer station should be carefully established considering the maximum anticipated river flood level.
- The existing dumped waste depth extends around 3.0 meters. Appropriate mitigation measures to allow for this should be considered while developing the site as a permanent transfer station.
- Environmental pollution, especially that affecting water quality and producing odor,

should be reduced as much as possible through mitigation measures. It is also essential that environmental monitoring be incorporated into the project's design and implementation.

- Outside workforce conflict (influx of waste pickers) is an aspect that needs to be carefully considered. The waste pickers are anticipated to approach the newly developed transfer station at Afadole, where a tipping area will be provided for vehicles without direct tipping facilities. However, the waste pickers may be overloaded in Afadole where LSMC intends to allow a maximum of 50 waste pickers to sort a daily waste amount of around 35 tons.
- A thorough study is required for identification of all parties, likely to be involved in the development and operation of the transfer station, with specific environmental responsibilities for effective implementation of mitigation measures and monitoring requirements during design, construction and operation phases of the project.

2) Technical Aspects

- Afadole site is suitably located for the development of the transfer station, but improvement of the access road along the Bagmati River should be implemented.
- If the site is developed from the start as conceived in the concept design, the capacity of the station may initially be greater than necessary. Some agreement may be made with KMC and KRM to receive some of their wastes at the site.
- In view of the above, and should LSMC consider the high cost for immediate development of the total concept design as an obstacle, as well as the number of transfer trucks available to LSMC, it may be advisable for LSMC to consider developing the site under Alternative 4.

CHAPTER 5 FOLLOW-UP FOR SECONDARY TRANSPORTATION AND SISDOL SHORT-TERM LANDFILL OPERATION

5.1 Follow-up for Secondary Transportation to Sisdol Landfill

5.1.1 Result of the Follow-up Survey

(1) Change of Situations for Secondary Transportation to Sisdol Landfill during Phase IV

1) Before Full Operation of Sisdol S/T-LF

The waste used to only be dumped at Bagmati Dumping Site but after Sisdol S/T-LF started partial operation on June 5, 2005 the destinations of the waste were as shown in the following figure, until full operation of Sisdol S/T-LF was started in May 2006.

In addition to the waste from KMC to Teku T/S "flow 1", MTM also transports there as "flow 2".

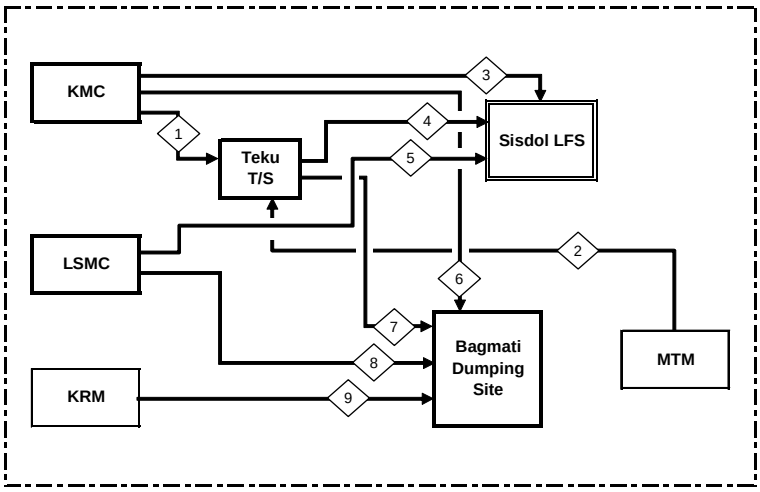


Figure 5.1-1 Waste Flow to Landfill (before Sisdol Full Operation)

Waste is directly transported to Sisdol S/T-LF from KMC "flow 3" and from LSMC "flow 5" and there is also the waste transported through Teku T/S from KMC "flow 4". After shifting Bagmati Dumping Site from the right bank to left bank on the KRM side, it was still used to accept the major proportion of the waste directly from KMC "flow 6", LSMC "flow 8" and KRM "flow 9". KMC was also disposing of its waste at the site through Teku T/S "flow 7".

2) Condition of Procured Secondary Transportation Vehicles

Twenty-one (21) units of Secondary Transportation Vehicles (STVs), which are categorized as container carriers, with spare parts and 18 units of extra containers procured under programs of Japan Non-Project Grant Aid 2003 were finally delivered to Teku T/S in December 2005. Seventeen (17) units are allocated for KMC while 4 units are for LSMC.

It was agreed that for appropriate operation of STVs within their design capacity the loaded weight should be under the 16.2 tons of Gross Vehicle Weight (G.V.W.), which means about 6 tons of waste loaded into the container.

3) After Sisdol S/T-LF Full Operation

After the 25 long days from April 6 to 30, when collected waste was not transported to either the Bagmati River Dumping site or Sisdol S/T-LF due to the confused situation in Nepal, secondary transportation was re-started. During the period of May 1 to 20, 2006, an approximately estimated 6,000 tons of waste were brought to the site. In addition to the daily waste collected, the waste accumulated at Teku T/S was transported to Sisdol S/T-LF. During those days, first priority for KMC was to transport all the collected waste to Sisdol Landfill. Therefore, KMC used almost all 17 STVs, except a few STVs that needed repair, to transport the waste to Sidol S/T-LF in addition to 7 units of the existing multi-compactor from Teku T/S.

On the other hand, as LSMC could not proceed with the tentative transfer station plan at Afadol yet, the existing small containers with 4 to 6 m^3 capacity at the public places in Sundarighat, near Industrial Estate, or Naya Basti were replaced by new containers with 15m^3 capacity.

(2) Result of Follow-up Survey

1) Conditions of existing waste collection / transportation system

a. KMC

KMC has 134 vehicles and heavy equipment for the solid waste management. Of these, 81 vehicles, such as hydraulic tippers, dumper placers and tractors, are used for primary collection. 25 vehicles, including the multi-compactors and STVs, are used for secondary transportation from Teku T/S to the final disposal site. 14 units of heavy equipment like backhoe loaders and dozers are used for operation at Teku T/S and Sisdol S/T-LF.

As one of the existing waste collection system, KMC is collecting the waste by removal containers with the capacity 4 to 6 m^3 located on certain places, named “container collection”. There are two types of containers provided by KMC for public collection and private collection. Public containers are provided free of charge by the municipality and are located at public common places or special sites such as Singha Darbar and Royal Palace.

Regarding secondary transportation of waste to Sisdol S/T-LF, it took 3 hours for a multi-compactor to make a round trip from Teku T/S. The transportation starts from 5:30 in the early morning and ends in the afternoon when the vehicle makes two trips.

b. LSMC

LSMC has 19 vehicles for waste collection / transportation with four types, 11 units of tipper, 2 units of dumper placer, 2 units of tractor and 4 units of STVs. In addition, LSMC has 2 units of backhoe loaders for solid waste management, of which, one is allocated for operation of Sisdol S/T-LF.

As well as KMC, LSMC also carries out container collection, placing containers at 13 different locations at present, 9 of public containers and 4 of private containers.

2) Preliminary trial operation of STVs

a. KMC

As the STVs were not ready to go to Sisdol S/T-LF, the preliminary trial operation, which is a loading and unloading examination, was conducted on March 2, 2006 within the Teku T/S in order to confirm the operation efficiency of STVs compared with the multi-compactor for future secondary transportation plan.

The trial was carried out during the day time when all the primary collection of the morning shift was already finished. Through this trial, the moving time, loading/unloading time, and total number of trips required by each vehicle for filling the container with waste and the loaded weight of waste were recorded.

The STV has a hydraulic system only for the hook lift equipment for loading/unloading of containers but the old multi-compactor has a more complicated mechanical system for a waste compaction plate and waste unloading plate. Considering these differences, the operation efficiency of the new STV is expected to be higher than the multi-compactor.

b. LSMC

As LSMC does not have a transfer station like Teku T/S yet, a trial operation for LSMC, this time on March 13, 2006, was carried out to evaluate the possibility of utilizing new 15 m^3 containers for container collection at public places. A container was placed at the left bank of Bagmati River in Sundarighat where the existing public containers were located.

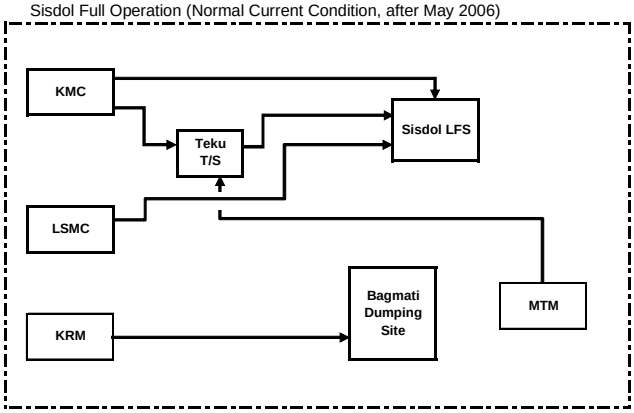
A time and motion survey was conducted on the trial operation recording the traveling time and distance for seven major sections of the road. The trail route was started from the LSMC garage with the final destination of the STV being Teku T/S, in cooperation with KMC.

The time of loading the container full of waste was measured at the site. When the STV reached Teku T/S, its weight with waste was measured by the weighbridge and then the waste was unloaded on the ground. The time taken to unload the waste and the weight of the empty STV was measured too. The STV went back to the same site for public containers at Sundarighat and a record taken of unloading/loading time of the empty container.

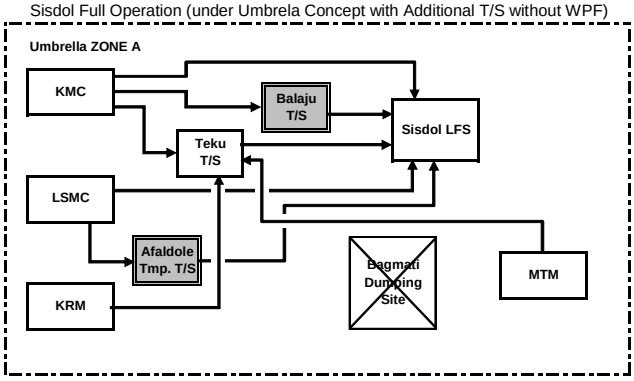
5.1.2 Suggestion for Primary Collection and Secondary Transportation Systems

Waste collection and transportation flow is depending on the availability of waste management facilities. The figures at the right are the current and future change of waste collection and transportation flows based on the umbrella concept.

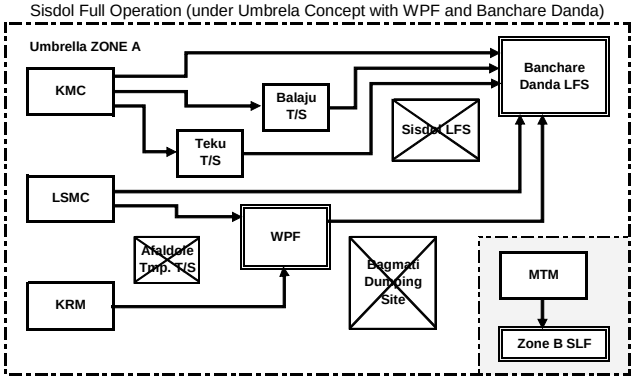
Sisdol Full Operation (Normal Current Condition, after May 2006)



Sisdol Full Operation (under Umbrela Concept with Additional T/S without WPF)



Sisdol Full Operation (under Umbrela Concept with WPF and Banchare Danda)



Currently, the waste collected from KMC goes to Sisdol S/T-LF directly or through Teku T/S. Since LSMC has not had any tentative transfer place, the waste should be transported to Sisdol S/T-LF directly. Considering the capacity of Teku T/S and total transportation cost, KMC needs to set up other transfer station(s).

In the mean time for both KMC and LSMC to proceed with the development plan for transfer stations, the waste transfer points that LSMC has introduced by replacing old small containers with new $15m^3$ containers should be also promoted in KMC to improve the loading capacity of both Teku and Balaju Transfer Stations.

In this connection, it is recommended both KMC and LSMC should exchange information more on their waste transportation situations so that LSMC will be able to obtain information for development and operation of the transfer station by KMC. Vice versa, KMC may learn how to operate the waste transfer point that LSMC are currently operating in cooperation with the private sector.

Because the number of STVs which LSMC has at this moment were calculated based on the condition that all solid waste collected in LSMC will be transported to the WPF. As LSMC may face difficulty in transporting all the waste collected to Okharpauwa with the existing transportation capacity if the WPF is not available, development of the WPF should be proceeded.

As for the primary collection, the solid waste management policy was changed frequently. Currently, once again, the solid waste is collected during day time, not night time and early morning that has been forced since February 2005. As it may take time to settle this frequent change of collection times, it is recommended that a time and motion survey be carried out for all the waste collection routes to improve the primary collection.

5.1.3 Suggestions for Operation of Teku Transfer Station

(1) Commencement of Direct Loading

Teku T/S has two types of waste transfer mechanism, one is direct loading at the platform developed and the other is indirect loading on the ground. Because of frequent changes of collection systems, such as from day to nigh and again to day time collections together with unstable political situation, as well as uncontrolled waste pickers and their demands, direct loading practices at the platform has not been in place yet. Since currently the day time collection was introduced in KMC again, it is a right time for KMC to start direct loading at the platform for quick waste transfer.

(2) Appropriate Vehicle Allocation

As shown in Table 5.1-1, the quantity of waste collected by the vehicles that can unload the waste directly to the STV is about 90 tons, which is less than half of the design capacity of the platform. This is because the design capacity is based on the future condition of waste collection vehicles owned by KMC in the A/P that all existing tractors will be replaced to small collection trucks with tipping devices. Design capacity also includes the increase of the waste quantity collected in future. From this fact, KMC should proceed the procurement of collection trucks with tipping devices, such as tippers, when the existing old tractors are replaced as discussed in the A/P. In addition, KMC should allow LSMC to use the platform till another transfer station at Afadol in LSMC is developed.

Table 5.1-1 Tentative Waste Allocation at Teku T/S

Unit: Tons/day

Loading Type	Design Capacity	Collected by	Average Quantity	Required Capacity*	
Direct loading	200	KMC Tipper	83.3	90	
Indirect loading	Depends on Loader numbers	KMC Tractor	66.8	70	210
		Private Sector	132.3	140	

Source: KMC and summarized by JICA Study Team

Note: *Round-up of the average quantity to adjust total quantity to 300 tons per day.

KMC can use 17 units of the new STVs and 7 units of multi-compactor to transport the waste to Sisdol S/T-LF but the multi-compactor has to be loaded with waste by indirect loading. The following table shows a tentative estimation for the vehicle allocation based on the condition that operation efficiency is 100%. Considering the maintenance of vehicles, total

carrying capacity of secondary transportation may be decreased and more trips to Sisdol S/T-LF may be needed.

Table 5.1-2 Tentative Vehicle Allocation from Teku T/S to Sisdol LF

Loading Type	Required Capacity [tons/day]	Vehicle Type	Trip No. [time]	Capacity per vehicle [tons/trip]	Capacity per day [tons/day]	Required Number of Vehicle
Direct loading	90	STV	3	6	18	5
Indirect loading	210	STV	2	6	12	11 or 12
		Compactor	2	6	12	6 or 7

Source: JICA Study Team

(3) Considerations to Waste Pickers

There was a provision within the concept design of Teku T/S to set aside an area within the station where the waste pickers would be able to continue their activities in a safer way and without effecting the transfer station operations. In parallel, a second provision called for KMC to register the waste pickers at the station in order to ensure there would be no sharp increase in the number of pickers operating there. However, since the closure of the Bagmati River dumping area, number of waste pickers has increased in Teku T/S without registration. KMC is again requested to take actions to introduce the registration system for allowing some waste picking activities without any trouble. For safety measurers to the waste pickers moved from the Bagmati River dumping area, it is also recommended for KMC to secure an appropriate sanitary environment to them such as providing regular medical checks along with the existing waste pickers. In addition, KMC should consider giving those waste pickers a preference to work at the waste processing facility to be constructed in future as operation staff.

(4) Development of Detail Operation Plan of Teku T/S

The local residents at Teku T/S are quite interesting how KMC manage the station. Their interests also included smooth operation and quick transfer of the waste at the site so that the environmental nuisances such as offensive odor from the site can be minimized. Therefore, it is recommended that KMC should have the meeting to let them participate to prepare the operation plan together.

5.2 Follow-up for the Operation of Sisdol Short-term Landfill Site

5.2.1 Follow-up for the Operation of Sisdol Short-term Landfill Site

(1) Follow-up Process

1) Sisdol Landfill Description

Valley 1 of Sisdol S/T-LF was developed as a semi-aerobic landfill. Sisdol S/T-LF was designed as a Level Three landfill, with leachate collection and treatment by aeration and re-circulation, and application of a clay liner. The facilities constructed for Valley 1 are shown in Figure 5.2-1.

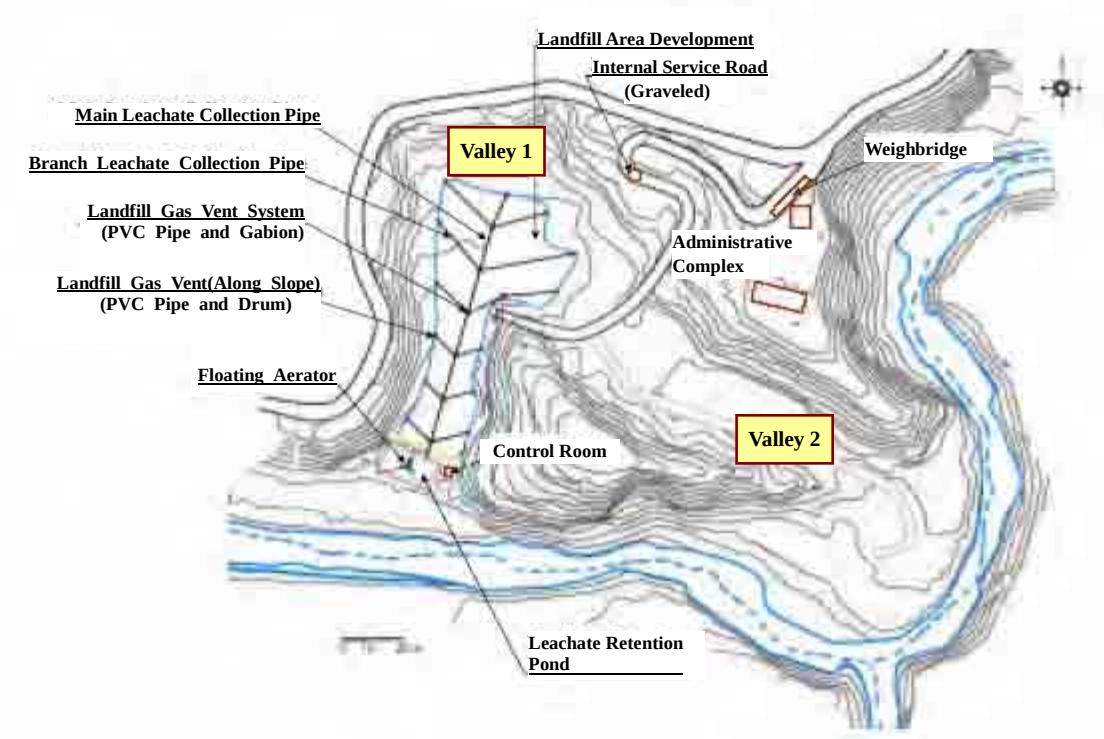


Figure 5.2-1 Sisdol LF Valley 1 Facilities

Source: JICA Study Team

The Valley 2 has been designed and developed by the SWMRMC and the site is almost ready to receive the waste as of March 2007.

2) Staging of the Activities for Capacity Development of Landfill Operation

The capacity development activities for landfill operation at Sisdol S/T-LF proceeded in five stages as follows:

Stage 1: (June – October 2005)

The landfill operation commenced with the start of the wet season and this somewhat hampered the activities that were expected to be implemented at this stage. During this stage the focus was on placing waste, preparation of internal site road for the wet season, preparation of initial waste platform, and maintaining the site records.

Stage 2: (November 2005 – January 2006)

During this stage the focus was on the development of the monitoring systems and forms, placing waste, soil cover, and vertical vent extensions. As the landfill development works were not completed in Stage 1, these became urgent activities for Stage 2.

Stage 3: (February – April 2006)

During this stage, attention was paid to the leachate re-circulation system. As the landfill operation approached the half-year mark the outflow effluent into the pond had stronger leachate characteristics and more focus was made on aeration, re-circulation of leachate and development of additional leachate storage capacity.

Stage 4: (May – August 2006)

This stage of the follow-up coincided with the commencement of full disposal operations at the site, as well as the advent of the wet season. Activities focused upon were improvements in the application of soil cover, placing waste, internal site road system and further considerations on leachate storage capacity.

Stage 5: (Sept. 2006 – March 2007)

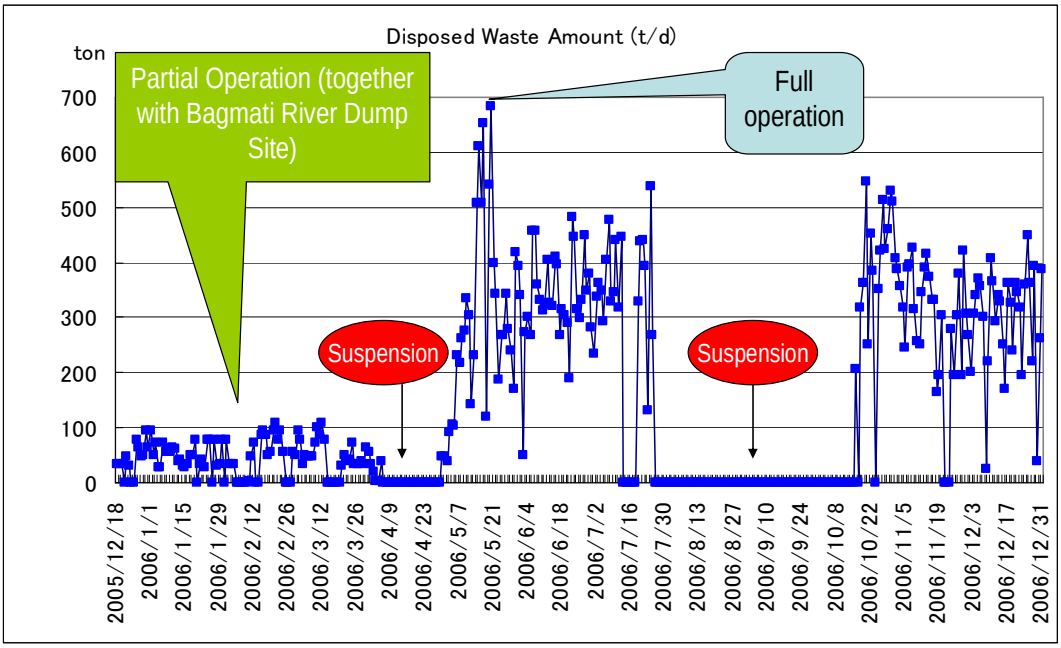
Activities in this stage dealt with the repair of damaged vertical gas vents, laying of additional horizontal leachate collection system, and construction of trickling filter in the waste layers, waste height control and markings, application of final cover and drainage system in the completed waste disposal area and commencement of waste disposal in Valley 2. In March 2007, the work shop at the site was organized by JICA with participation of the staffs relating landfill operation from neighboring countries.

(2) Operation Conditions

1) Chronology of the Waste Disposal

Figure 5.2-2 shows the chronology of the waste disposal, i.e. the monthly waste arrivals in ton/day (left hand side vertical axis) and the number of hours the aerator and re-circulation pump were operated daily (right hand side vertical axis) for the representative months of January 2006 (partial operation) and June 2006 (full operation).

- Oct.2004-March 2005 (6 months): Detailed design and construction
- June 2005-April 2006 (11 months): Partial operation (30-50 t/day)
- May 2006- : Full operation (300-400 t/day)



Waste amounts arriving at Sisdol LF (December 2005 – December 2006)

Figure 5.2-2 Chronology of the Waste Disposal

Source: JICA Study Team

Waste disposal operations were suspended for two long periods, in April 2006 (22 days) and from July 28 up to October 15, 2006 (80 days) In addition, short suspension periods occurred many times.

2) Operation System

The Sisdol S/T-LF has been operated under the following conditions

① Operation is managed by Environmental Department of KMC

② Waste collection and haulage trucks arrive in two shifts daily (on some days three shifts are operated).

③ Waste arrival records are maintained at the site manually

④ Two other records are maintained at the site; one for description of daily operations and the second a visitors book

⑤ Prior to the dissolution of the OSLSMCC, bi-weekly meetings were held with the participation of KMC, LSMC and the OSLSMCC to discuss operational issues

⑥ Heavy equipment; up to April 2006, only one bulldozer and one loader were available at the site. From May 2006 and with commencement of full operation a sheep-foot compactor and additional bulldozer were brought to the

site. During the operation improvement (Stage 5) an excavator was hired and extensively used at the site.

⑦ Light equipment; a generator was used to operate the aerator and re-circulation pump, due to delay in connection of electric power

3) Monitoring System

Site visits were made at least twice a week (increased to 3 times per week upon full operation) and data and information were collected, coded and input into an Operation Monitoring Visit Report (OMVR). The data and observations cover the following items:

- Visit date, time and weather
- Landfill operation
- Equipment conditions
- Manpower at the LF
- Environmental concerns
- Others, including general comments

The Weekly Monitoring Report (WMR) was also prepared based on the records maintained by the Operator at the Site and some survey works. The main components of the WMR were as follows:

- Collection truck arrivals
- Manpower at the LF
- Equipment in operation
- Waste placement progress

(3) Follow-up Results

1) Overall Results

Findings

The main operation monitoring data are summarized in Table 5.2-1.

Table 5.2-1 Main Operation Monitoring Data

No.	Item	Unit	Dec. '05	Jan. '06	Feb. '06	Mar. '06	Apr. '06	May '06	Jun. '06	July '06	Oct. '06[3]	Nov. '06	Dec. '06
A	DATA												
1	Recording Period	day	21	31	28	31	30	31	30	31	31	30	31
2	Waste Arrivals												
	2.1 Operating days	day	17	28	18	25	6	31	30	19	14	27	30
	2.2 Trips	trip/m	115	234	183	221	32	1,384	1,458	1,077	901	1,341	1,381
	2.3 Waste amount[4]	ton/m	687	1,490	1,179	1,423	143	9,381	10,032	6,894	5,729	8,677	9,170
3	Staffing at LF												
	3.1 Site Manager	d/m	5	4	6	5	1	20	23	8	16	27	28
	3.2 Asst. Site Manager[5]	d/m	14	27	17	18	7	36	84	42	20	30	43
	3.3 Dozer/ compactor operator	d/m	14	28	17	25	4	58	104	29	14	30	29
	3.4 Loader/ excavator operator	d/m	13	28	17	23	6	31	30	29	17	30	30
	3.5 Workers	d/m	84	186	168	186	180	177	180	165	51	90	90
	3.6 Guardsmen	d/m	42	62	56	62	60	62	60	58	34	60	60
	3.7 Mechanic[6]	d/m	1	5	2	2	0	24	21	5	0	40	37
4	Equipment												
	4.1 Weighbridge	hr/m	0	0	0	0	0	0	0	0	0	0	0
	4.2 Aerator	hr/m	34.5	18.75	10	49	11	55	37	1	1	4	2
	4.3 Re-circulation pump	hr/m	30	73.25	38	36	36	61	64	32	60	104	55
	4.4 Generator I (pilot project)	hr/m	65	92	48	85	47	118	100	33	60	104	55
	4.5 Generator II (KMC)	hr/m	0	0	0	0	0	0	2	0	0	0	0
	4.6 Bull dozer	hr/m	42.5	90.5	81	102	15	257	262	108.5	58	153.5	248
	4.7 Loader/ excavator	hr/m	5	35	35	37	6	137	148	56.5	127	285	139
B	ANALYSIS												
1	Operating days/ month	%	81%	90%	64%	81%	20%	100%	100%	61%	45%	90%	97%
2	Ave. trips per operating day	trip/d	6.8	8.4	10.2	8.8	5.3	44.6	48.6	56.7	64.4	49.7	46.0
3	Ave. waste per operating day	t/d	40.4	53.2	65.5	56.9	23.8	302.6	334.4	362.8	409.2	321.4	305.7
4	Leachate Treatment												
	4.1 Aerator ave. hr/operating day	hr/d	2.0	0.7	0.6	2.0	1.8	1.8	1.2	0.1	0.1	0.1	0.1
	4.2 Pump ave. hr/op. day	hr/d	1.8	2.6	2.1	1.4	6.0	2.0	2.1	1.7	4.3	3.9	1.8
5	Waste placement with cover												
	5.1 Bull dozer ave. hr/ op. day	hr/d	2.5	3.2	4.5	4.1	2.5	8.3	8.7	5.7	4.1	5.7	8.3
	5.2 Excavator ave. hr/op. day	hr/d	0.3	1.3	1.9	1.5	1.0	4.4	4.9	3.0	9.1	10.6	4.6
6	Administration Staff												
	6.1 Site manager presence rate	%	29%	14%	33%	20%	17%	65%	77%	42%	114%	100%	93%
	6.2 Asst. Site mgr presence rate	Per/ op.d	0.8	0.96	0.94	0.7	1.2	1.2	2.8	2.2	1.4	1.1	1.4

Source: JICA Study Team

Interpretation

a. Waste arrivals

- In April Sisdol S/T-LF was mostly closed, except for 6 working days due to the pro-democracy movement. Full operation with all KMC and LSMC wastes coming to Sisdol S/T-LF, started in May, and for both months of May and June operation was un-interrupted. On July 27 the operation was suspended due to

[3] Sisdol LF was closed in August and September 2006
[4] Waste amounts estimated and not weighed
[5] A second assistant manager was added with the start of full operation at Sisdol
[6] Comes to LF upon request – In November and December 2006 mechanics were often at the site to change the bulldozer chain

problems with the local community over delays in commencement of promised development projects in the area. Operation was restored in mid October 2006.

- Average waste arrival increased gradually from 40 to 66 t/d during the period of December 2005 to February 2006. The peak amount during that period was around 100 t/d. With full operation, the average amounts of arriving waste were 303 t/d in May and peaking to 410 t/d in October 2006.
- In May the amount of arriving waste peaked to just short of 700t/d due to transport of waste stored at Teku T/S in April 2006.

b. Leachate treatment – Aeration and Re-circulation

- The aerator should be operated at least 6 hours daily. Obviously the average operating time is presently too low.
- It is recommended that the pumping system be operated at least 2 hours daily to achieve further treatment and as required when the pond capacity becomes full.
- Due to the lack of electricity power supply, it was difficult to operate both the aerator and re-circulation pump at the same time.
- Due to frequent generator breakdowns, neither the aerator nor the pump were operated often.

c. Waste placement and soil cover

- The bulldozer spreads the waste and in the absence of a compactor is supposed to compact the waste through a number of passes over the spread waste.
- The loader/excavator is used to excavate soil cover material, basically from Valley 2, and for moving the materials to the waste placement area, or loading onto a tipper to take the material to the waste placement area.
- One bulldozer was operated at average 3-4 hours per operating day. Considering that the dozer was used for (1) pushing the waste to the disposal area, (2) spreading and compacting the waste, (3) pushing and spreading the cover soil, and (4) preparing the internal site roads, it is obvious that the desired compaction could not be achieved.
- With the start of full operation, an additional dozer and compactor were operated from May 2006, for an average 8-9 hours/operating day. Compaction conditions started to improve.
- Efforts were made to operate the compactor during the wet season. However due to frequent breakdowns and the poor condition of the compactor, operation was not possible.
- The excavator should be used more efficiently to stockpile materials for the cover, and not only to excavate for one day's waste.

- Placing waste continued to be a problem at the site up to April 2006, because of the lack of heavy equipment to prepare an internal road so that the waste haulage trucks could directly empty the waste at the disposal area.
- After May 2006, the operator began to develop the site roads and waste platform to be able to bring trucks up to the disposal areas.
- By the first week of July 2006, it was estimated that 26,719 tons of waste had been disposed of at the site and 8,775 tons of materials had been used for the cover soil. In terms of weight the ratio of cover soil to disposed waste was around 25% (by volume it is around 20%).

d. Site Management

- The Site Manager is at the site at least once a week.
- The Assistant Site Manager is at the site almost every operating day.
- With the start of full operation, additional staff was added to the site and the management improved.

2) Leachate

The leachate pond had a capacity of over 500m^3. The leachate quantity measured at the main collection pipe outlet peaked to 15m^3/d towards the end of December but averaged 13 to 15m^3/d during January 2006. During the wet season the quantity was 80m^3/d.

The main source of the leachate then was the seepage of mountain water from two streams that used to pass through the site. The perimeter cut-off drain that has been constructed to divert the two streams to the river, bypassing the site, is not capable of completely stopping the water from percolating under the drain and into the site. This is evident from the figures showing the quantity of water captured at the cut-off drain, which were at around 5m^3/d.

A second source of water is the moisture content of the disposed waste. Based on the JICA Study Team survey, during the dry season, household waste, which comprises the majority of the waste content, had a moisture content of 55%.

Further reference to the graph shows that the main leachate pipe outlet flow jumped by about 10m^3/d to around 23m^3/d at the start of March (while the cut-off pipe quantity at the same time was zero). The increased water quantity flowing into the leachate pond was due to percolation of part of the re-circulated leachate from the pond into the waste back to the pond.

In the wet season, the pond was not capable of relieving the leachate pond. The Valley 1 pond will be connected to Valley 2 pond to enhance the leachate storage capacity of Valley 1.

3) Environmental Conditions

Soil Cover application

The daily cover is not being applied to the solid waste. *Daily application of soil cover is a fundamental operational aspect of sanitary landfill and should be implemented.*

Odor

The leachate pond generates a strong odor, especially when the aerator is operating, and there have been complaints from farmers cultivating land on the other side of the river. Also there have been complaints by the military check points leading to the Tinpiple road on the smell of the waste transport trucks. As ponding is observed over the northern area of the site and there is a distinct leachate smell from there.

Vectors, dogs and birds

Insects may be observed at the surface of the leachate pond and the higher re-circulation pond. Dogs appeared at the site early in December and have been continuous "guests" there. In early January 2006, KMC exterminated the dogs but they reappeared. Eagles were observed at the site and gulls began converging on the site.

Waste scattering

Waste scattering has not been observed at the access road leading to the site and is not a significant problem at the disposal site area.

4) Waste Placement

The site is divided into zones. Employing a theodolite, the waste levels at each zone are measured and the waste volume (+ cover soil) is estimated. Presently (March 2007) the total waste and soil volume is estimated to be around 50% of the total fill volume.

a. Planned waste placement

It is normal practice to limit the area of the working face in order to keep the soil cover material amounts required to a minimum and decrease the leachate produced. KMC has been trying to operate the waste disposal within such parameters but has been hampered by the lack of reliable and sufficient heavy equipment. The bulldozer budgeted for by KMC over one year ago has still to be procured.

b. Waste Unloading and Spreading Operations

During the wet season it was difficult for the trucks to empty at the waste disposal areas because of poor site road conditions. With the commencement of full operation KMC has been preparing a "waste platform" using gravel material so that when the wet season comes the trucks will be able to access these areas and empty the waste for disposal in the northern area of the site. An internal access road was developed up to the waste dam to facilitate the waste trucks reaching the waste disposal areas.

Another aspect of the operation is the spreading operations; pushing down of the waste. This should theoretically allow for proper compaction of the horizontal surface of the disposed waste. However it has been noted that after emptying of the waste the dozer spreads the waste but does not make enough passes over the spread waste. In the absence of the compactor, the dozer should at least make 3-4 passes over the spread waste.

5) Landfill Gas Monitoring

The values measured are indicative of the methane content of the landfill gas mixed with surrounding atmospheric gases as it is emitted from the land filled waste.

In the case of the high methane value obtained at B13 of 24% on February 22, 2006, the measuring rod could not be inserted in the vent, which was found to be blocked. The rod was inserted in a small hole at the base of the vent. The high methane concentration could be due to the fact that the gas emitted from that small hole was not diffused with the atmospheric air.

Relatively higher methane values were obtained from the vents located in the north part of the waste disposal area. This can be explained by the fact that waste placement started in the north in June 2005 and gradually spread southwards.

6) Other Operation Monitoring Aspects

In addition to the monitoring activities discussed above during the site visits other aspects were monitored as follows:

a) Inspection of the manhole valve, which controls the leachate release from the pond to the adjacent river, to ensure there is no leakage.

b) Observation of the site slopes to monitor collapse or landslides.

c) Check that the perimeter cut-off drain is clear to allow free flow.

d) The road leading into the waste area was very difficult to maintain during the rainy season but it has since been improved.

e) In addition to the river water sampling and analysis, visual inspection of the river stretch along the Valley 1 south border.

f) The site records maintained by the operator are monitored to ensure that they are kept to date.

g) Two boreholes fitted with piezometers in order to sample and monitor the ground water are regularly monitored to ensure that both the fence and caps are maintained.

h) Major complaints were concerning the release of leachate into the river, odor, and slaughterhouse waste being received at the site. Due to poor maintenance of the pump and generator together with lack of electricity, the re-circulation system has not been functioning well.

5.2.2 Result of the Water Quality Test at Sisdol Landfill

Water samples have been taken on ten different dates from the Kalpu Khola River running south of Sisdol S/T-LF, the boreholes downstream of Valleys 1 and 2 and the leachate generated from the disposed wastes. The first four samplings were performed on dates before the operation commenced. The results of these tests are summarized below:

(1) River Water Monitoring

The results indicate that on the whole there has been no detected impact from the waste disposal activities on the river water. COD values slightly increased after operation, but remain well within the acceptable norms. The Total Suspended Solids showed a high level of 474 mg/l in July 2005 downstream of the site, one month after disposal commenced, and this may be explained by the irrigation and farming activities.

(2) Groundwater Monitoring

Groundwater samples are obtained from two boreholes; BH-1 located south of Valley 1 waste dam (where the waste disposal operation is ongoing) and BH-2 located downstream of Valley 2. When compared to the respective results before the operation, only the DO result of the Sisdol S/T-LF in BH-1 rose, to 6 mg/l, after the start of operation. Other values remained within the same limits as those of the samples taken before waste disposal started.

(3) Leachate Quality

Leachate samples are taken from the main leachate collection pipe outlet (i.e. before the leachate pours into the pond) and from the leachate retention pond. Comparative analysis of both samples should show the effect of aeration on the quality of the leachate. However as reported earlier, aeration is not being done to the required standards due to many reasons so there was not much difference.

During the March sampling the pond was aerated for about 30 minutes, after which the pond sample was taken. For the June sampling, aeration was done for 6 hours before the pond sample was taken. BOD and COD values for samples of the raw leachate rose to 69,000 and 104,000 mg/l respectively. However with 6 hours of aeration the respective values from the pond sample fell to 32,500 and 43,680 mg/l, i.e. to less than half of the raw leachate values. Ammonia Nitrogen also fell from 996 mg/l to 501 mg/l. It is therefore necessary to properly aerate the leachate for at least 6 hours daily.

5.2.3 Training for Improvement of Operation of Sisdol Landfill

In order to improve operation of Sisdol S/T-LF, instruction to the operators and training in situ was conducted three times, September, December 2006 and March 2007, by landfill site operation experts as show in Table 5.2-2.

Table 5.2-2 Training for Improvement of Operation of Sisdol S/T-LF

Date	Instruction and Training Items
September 16-21, 2006	- Landfill method and daily soil cover - Improvement of gas ventilation facilities - Measuring of methane gas concentration generated from landfill - Rainwater drainage planning
December 10-16, 2006	- Operation and maintenance of landfill - Maintenance of heavy equipment - Improvement of gas ventilation facilities - Landfill method (leveling and installation of landfill height makers)
March 1-14, 2007	- Operation and maintenance of landfill (Installation of a leachate re-circulation bed and drainage in Valley 1) - Improvement of gas ventilation facilities (Preparation of gabions for gas ventilation facilities) - Landfill method (leveling and installation of landfill height makers in Valley 1 and the first layer in Valley 2, leveling and final soil cover)

Source: JICA Study Team

5.2.4 Suggestions for Operation of Sisdol Landfill

The suggestions offered here are meant to improve the existing operation of Sisdol S/T-LF, based on the lessons learnt so far.

(1) Vertical Gas Vents

Issues:

a. Some vents may be blocked.
b. Some vents are supported by old tires which hinder flow of leachate into pipes.
c. Some vents are surrounded by soluble gravel which dissolves in leachate and may block pipes.

Recommendations:

a) Identify the blocked vents requiring repair.
b) For repair excavate as deep as necessary and remove the surrounding wastes and old tires, clear the vents and insert insoluble boulders, within a diameter of 1 meter minimum.
c) For extending the vertical vents above the waste, support the extended sections by gabion or used drums with diameters of 1 m.

(2) Waste Placement

Issue:

a. Waste trucks have difficulty accessing disposal area.
b. Waste spread over too large an area.
c. Excessive use of soil materials for cover over a wider area.
d. Leachate production may be increased.

Recommendations:

a) Operator should continue to develop the waste platform.
b) Temporary internal site roads may be prepared using old waste.

c) Areas identified for waste placement should be decided before the day's work.

d) Additional bulldozer should be brought to the landfill.

e) The weighbridge should be operated daily.

(3) Leachate Amount

Issues:

a. During the wet season the Leachate Pond (lower pond) becomes full within 3-4 days.

b. The upper re-circulation pond (prepared in February) is not effective during the wet season and has become a source of odor and insects.

c. Insufficient leachate re-circulation does not help decrease the volume.

Recommendations:

a) The Leachate Pond should be regularly cleared of sludge.

b) Finished areas of the landfill should be provided with a final cover and rainwater drains.

c) The SWMRMC proposal to construct leachate ponds at Valley 2 and receive part of the Valley 1 leachate should be implemented.

d) The upper re-circulation pond has served its purpose and it should be filled, and a final cover applied to that reach of the disposed waste.

(4) Leachate Re-circulation

Issues:

a. The flexible hoses designed to convey the pumped up leachate to the sprinklers mounted on the vertical vents are easily damaged and disturb the waste landfill operations.

b. The pump is frequently out of order as well as the generator.

Recommendations:

a) The flexible hoses should be replaced with rigid pipes mounted along the site perimeter and linked to small leachate "fountains" within the site.

b) A Trickling Filter needs to be constructed at the different waste lifts in order to filter the re-circulated leachate as it is directed towards the vertical gas vents.

c) The pump should be regularly maintained and operated daily.

(5) Leachate Treatment

Issues:

a. The aerator, along with re-circulation is the only treatment provided for the leachate and therefore it should be operated daily for a minimum 6 hours.

Recommendations:

a) The aerator should be regularly serviced and operated for at least 6 hours daily.

b) The electric power should be speedily provided to the site.

c) A charcoal plant may be set up to further treat the leachate after aeration.

(6) Leachate Ponding

Issues:

a. The leachate collection network comprises a horizontal network laid on the landfill bed and vertical vents; no pipes are provided along the slopes.

b. Some of the vertical pipes are blocked.

Recommendations:

a) Vertical vents should be checked and any blocked vents cleared, as well as the area surrounding the vents.

b) Inclined trenches with boulders should be dug from the northern area to the vertical vents to drain the leachate.

(7) Others

Site Management

1) The site manager needs to spend more time at the LF.

2) KMC and LSMC need to provide the necessary heavy equipment and staff.

Monitoring of Operations

1) The leachate, groundwater and river should be tested at minimum on a bi-monthly basis.

2) The complaints and remarks should be recorded and dealt with.

3) The Environmental Coordination Committee should commence its work immediately.

Site Operation Records

1) Operation Records, Waste Arrival Records and Visitors Logs should be maintained.

2) Weighbridge at the site should be made operational as soon as possible.

3) Explanatory materials for the LF should be prepared.

Completion of the Development Works

1) Electric power should be immediately provided to Sisdol Landfill.

2) Site fence, especially in the leachate pond area should be completed.

.

5.3 Recommendations on Further Facility (Landfill Site) Development and Operation

Based on the experience gained from the design, construction and operation of the Sisdol S/T LF there are a number of recommendations, which have been considered in the concept design for Banchare Danda LF and/or other landfill sites. Main recommendations are as follows:

(1) Development

- Although the river flow during the rainy season is strong, it is recommended that a pond with enough capacity to prevent discharge into the river be considered. Accordingly for Banchare Danda LF, the leachate quantity was estimated for 30 years continuously (20 years of operation + 10 years for post closure maintenance).
- It is recommended that the internal road system of the landfill site should be designed with all weather roads.
- Much attention should be given in the design towards developing the facilities to limit the ingress of rainwater into the waste disposal area.
- The fence and gates must be constructed before the site starts receiving waste.
- From the development stage leachate collection along the slopes should be considered.

(2) Operation

- In order to make the operation easier and limit leachate generation, the landfilling site should be divided into sections. Accordingly, the operation guidelines for Banchare Danda have divided the site into four sections.
- Enough blowers should be provided at the leachate pond to ensure sufficient aeration. Further, the re-circulation system should be improved to include a rigid piping system.
- A more suitable source of materials for waste cover should be considered so that the semi-aerobic system will be more active.
- In addition to the road developed at the commencement of the waste disposal, service roads have to be developed periodically to ease the access of the waste collection trucks to the site.
- The vertical vents should be extended using gabion nets and surrounded by boulders. The boulders placed should be, at minimum, 1.0 m diameter. Furthermore as the waste height increases, if necessary, a secondary system for leachate collection should be constructed (at about 20m levels) to enhance the semi-aerobic system.

CHAPTER 6 RECOMMENDATIONS FOR FURTHER ACTIVITIES

The A/P is a long-term strategic plan to be implemented over the period starting fiscal year 2005/2006 (2062/63) to 2014/15 (2071/2072). In order to ensure the implementation of the A/P in an effective and sustainable manner, there needs to be put in place a monitoring and evaluation system that binds together both individual and collective achievements of the SWMRMC and the five municipalities. Although the politically unstable situation of Nepal has much influenced the progress of scheduled activities in the AWPs of the fiscal year 2005/2006 (2062/2063), there have been lessons learned from the first year's experiences. From those, further action plans to be tackled independently by the SWMRMC and the five municipalities are recommended for implementation.

6.1 Lessons Learned from FY 2005/2006 (2062/2063)

At the series of monitoring sessions, lessons learned from the implementation of the scheduled activities and challenges and constraints faced by the municipalities were collected as follows:

6.1.1 SWM Planning and Budgeting

Introduction of the planning, implementation and evaluation cycle in the municipalities has been found to be useful in practice for more effective solid waste management. AWP preparation and budgeting has had a distinct impact on the municipal program and budget for SWM. As it may take time to enroot such organizational culture in each of the five municipalities, it is recommended that it be mandatory to continue the monitoring system. An annual work planning – budgeting – implementation – evaluation cycle should be practiced in the municipality as an official process.

Considering the currently changeable situation in Nepal, amendments of the A/Ps based on the situation as well as progress of the scheduled activities may be necessary. Therefore, regular periodic reviews including a mid-term review of the A/Ps are recommended. A review of the A/Ps by the central government (MOLD/SWMRMC), with publication of the results, may also help with practical implementation of the A/Ps.

Annual work planning and program based budgeting has contributed to building a linkage between short-term planning of the A/P and activities to be conducted in each fiscal year as a budgeted AWP. Although a small step, this has also helped to institutionalize the planning/decision making process even though the unstable political situation has delayed the process in the last fiscal year.

The A/P was prepared in a participatory way involving relevant municipal sections and key stakeholders in Task Force and TWGs. As the relationship of the SWM section with other

sections is further enhanced by being involved in the implementation process, it is recommended that this practice be continued.

6.1.2 Remarkable Progress of Activities by Respective Municipalities

(1) KMC

The operation of Sisdol S/T-LF has provided good opportunities to learn about sanitary landfill as well as semi-aerobic landfill development, operation and management. A series of discussions and meetings, which were conducted with the local people to obtain their consensus at different stages, provided experience in involving the local community in the social considerations of landfill management. The operation and management of SWM facilities especially landfill sites in an environmentally sound manner is a big challenge, which needs to be continuously met by KMC together with LSMC and SWMRMC.

(2) LSMC

There has been significant progress in LSMC with community participation in SWM. Several programs on community awareness raising were conducted in the last fiscal year (2005/2006). NGOs/CBOs/Women groups and nature clubs have shown much interest in SWM and they have a good relationship with LSMC and have actively been working in SWM.

Expanding door-to-door collection by the private sector has decreased collection points and there has been an identified improvement in the solid waste collection situation. It may be good experience to proceed with improving the collection and transportation system as well as private sector collection.

(3) BKM

Although it could not be extended to other areas, waste separation at source with support nature clubs organized is the best practice, which has been continuously conducted in the last fiscal year, in BKM. Although a good deal of effort is still needed, they are pushing forward with the consultative process of landfill site development by using consultation experiences of source separated collection through joint effort and cooperation among the sections concerned and central government.

(4) MTM

MTM staff has been responsive and collective works have been done to implement the scheduled activities in the AWP. The Community Development and Sanitation Section (CDSS), where two staff are working, has been made mainly responsible for implementing

the A/P. Under CDSS, efforts for waste minimization have been made at the community level and MTM has sustained promotion and cleaning campaigning.

(5) KRM

The municipality has started to regularize private operators on solid waste collection. The PPP in SWM Guideline, which was developed during the Study, has been adopted and the procurement processes initiated. The tendering process for PPP was completed and it is expected that selection and agreement will be completed in the near future. If KRM does sign an agreement with the selected private parties, KRM will be the first municipality in the valley, to complete formal process of PPP in SWM.

6.2 Lessons Learned from FY 2005/2006 (2062/2063) for Specific Activities

6.2.1 Collection and Transportation

(1) Secondary Transportation

The current number of new secondary transportation vehicles (STVs) was estimated with the assumption that the future facilitation scenario would follow the umbrella concept in order to optimize the initial investment. However, in reality, KMC could transport all of their collected waste to Sisdol S/T-LF without an additional transfer station. This is the reason why KMC uses the new STVs and seven units of old multi compactor trucks, conducting more than three trips per day with overtime work and also dispatches small capacity tipper trucks.

It should be understood that current full-scale transportation may be at more than 100% operation capacity and could quite easily collapse. Needless to say, the mechanical equipment needs regular maintenance and inspection to maintain this performance. Transportation by small trucks may need more fuel than required if larger ones were used and may affect the primary collection system. Therefore, it is recommended that efforts be continued to develop additional transfer stations and waste processing facilities to minimize waste to be transported as well as to procure additional STVs.

(2) Operation of Teku Transfer Station

The changes of waste management policy from night-time collection to day-time collection definitely affect the operation of Teku T/S again. KMC is advised to prepare the operation plan of Teku T/S with the participation of local people taking into account the balance of waste and vehicles into and from the station. Also to operate Teku T/S more effectively it is required that both entrances to the site are used (in order to segregate haul truck and collection truck traffic).

It should be also noted that during May, June and July 2006 when all the waste was transported to Sisdol S/T LF and Bagmati Dump Site was closed, the number of waste pickers at Teku almost doubled. It is recommended that consideration be given to the appropriate number of waste pickers that can work at Teku without hindering the operations and endangering their own safety, and registering them. It is also necessary to consider options for the remaining waste pickers.

(3) Development of Other Transfer Stations

Concerning KMC's intention regarding Balaju T/S as shown in their short term plans; it is recommended that KMC proceed with the IEE for the site, and secure the budget for EIA and construction.

LSMC has determined that a T/S is required in order to transport its waste to the Sisdol S/T-LF. Afadole site, which is conveniently located and has a large area. It is recommended that LSMC start studying ways to construct the temporary transfer station at this site, through discussions with the surrounding community.

6.2.2 Waste Minimization

(1) Large-scale Waste Minimization Facility

The SWMRMC and KMC should continue with efforts to solve the issues related with site selection as well as others for development of a waste minimization facility. The authorized working group should be functioning soon.

(2) Local Level Waste Minimization Activities

1) Operation of Medium-scale Vermi-composting

The following are recommended for ensuring the sustainability of the vermin-composting plant operation:

- Supply of vegetable wastes from the vegetable market to the KMC plant should be secured.
- Working environmental conditions should be improved, especially for the rainy season.
- Labor conditions also should be improved, for example salary of staffs/workers should depend on amount of produced compost to increase motivation, and working wear should be supplied.
- Marketing of vermi-compost should be done effectively with an attractive brand, product launch, and promotional activities.
- Improvement of compost quality should be studied, for example using cow-dung as a raw material.
- Entrusting the management of the vermi-composting plant to a suitable NGO or private sector should be considered.

- The plant can be utilized as a training institute for vermin-composting technology.

2) Community-based Waste Minimization Activities

a. Operation of Recycle Center

The following are recommended for sustainable CRC operation:

- A catch phrase on recycling of waste such as "Recycling solves the waste issue and changes trash to cash" should be shown on the CRC booth.
- The purchase price list for recyclable waste including household made compost should be indicated on the CRC booth and distributed with above-mentioned catch phrase.
- Opening hours also should be indicated on the CRC booth.
- The CRC should not only be recycling center, but also an information center on solid waste management at the community level.
- For the sustainability of the Center, the scope of work of the Center has to be expanded in addition to collecting recycling materials.
- KMC should arrange funds to support recycling centers, because all activities cannot be judged in economic profitability. Reduction of waste at the source and reuse of the materials is itself a great activity to reduce pollution.
- The CRCs should be established at other wards based on experience of this CRC.

b. Home Composting Activities

Community based composting is also a useful method for waste minimization. It is desirable that community based composting be expanded based on the successful operation in KMC.

For sustaining and expanding home composting, the following are recommended:

- Municipality should subsidize HCBs as appropriate as possible so that residents can acquire one easily in cheaper price, but should also motivate composting operation by sharing a certain amount of bin cost.
- Periodical monitoring and advice should be done by employing motivators. Trouble shooting for composting operation should also be done quickly and surely.
- HCBs and the operation manual should be improved according to operational experiences.
- Municipality should arrange places/opportunities, like the CRC, for those who want to sell the compost product for earning money.
- Considering the present situation that some compost products are being sold at markets/shops, the sales market of the compost products is expected to be secured. Since the result of the market survey conducted in the Study revealed that there is a potential for use of compost by farmers in and around the valley, Municipality should also monitor and encourage the sales market of the compost products continuously.
- Effectiveness of the home compost product in crop growth should be studied continuously and demonstrated to bin users.
- Information on not only home composting but also other waste minimization activities should be shared through CoMoN meeting periodically.

c. Plastic Separation Activities

Assignment of a motivator is one of reasons for successful continuous activities and remuneration of the activities of plastic separation in KRM. Thus, motivators should be continuously appointed for effective monitoring and follow-up of the activities.

6.2.3 Final Disposal

(1) Sisdol S/T-LF

Although Sisdol S/T-LF is operated mainly by KMC, it is recommended that LSMC and the SWMRMC become more involved in the operation of the site. It is also urgently recommended that KMC, LSMC and the SWMRMC revive the spirit of cooperation upon which the agreement was signed between the three parties and the local residents through honest discussions and mutual understanding of their needs.

(2) Banchare Danda LF

The SWMRMC is progressing with the EIA to develop the site. The construction schedule, particularly that required to implement "pre-construction" activities, is vital to the commencement of construction.

The SWMRMC should carefully consider its capacity to cope with all the activities related to implementing this large project. Manpower and budget need to be allocated. As required, SWMRMC is also recommended to include KMC and LSMC in the development phase of the project in order to benefit from their strengths as well.

(3) Continuity of Sanitary Landfill Operation

The Sisdol S/T-LF is expected to be completely filled by January 2008, assuming that all the waste collected at KMC, LSMC and KRM will be brought to the site[1]. On the other hand, Banchare Danda LF is expected to be ready to receive the waste by July 2009. It is therefore necessary to consider what measures to take to landfill the waste during this period. One alternative that could be considered is to use the Aletar land, purchased by the SWMRMC, of Sisdol S/T LF for a temporary landfill.

(4) Development of a long term Landfill for Zone B

It is recommended that BKM seek more of community discussion on establishing the landfill site including discussions with communities outside where the proposed site is located. A balance of opinions is needed.

[1] If there is improved waste placing and compaction (assuming a compacted density of 1 t/m^3 and 20% soil cover) then the Sisdol S/T LF life may be extended up to July 2008.

The SWMRMC should play a larger role in this matter, as they are the government agency responsible for development of sanitary landfill within the valley. Again this requires that the SWMRMC enhance both its manpower and budget.

(5) Closure of Bagmati Dumping Site

The action plans of the SWMRMC, KMC and LSMC called for safe closure and rehabilitation of the Bagmati dump site. Nature is kind to Kathmandu Valley as witnessed by the quick growth of green areas around the Bagmati River dumpsite. However, problems of methane gas generation as well as leachate still prevail. It is recommended that, in the absence of effective safe closure, people should be warned of the dangers of tapping onto unpurified methane gas, building upon old dumpsites and playing in the river near these areas.

APPENDICES

- APPENDIX 1 Members of the CKV Study and Committee
- APPENDIX 2 Technology Transfer Seminar
- APPENDIX 3 Selected Photos

APPENDIX 1

Members of the CKV Study And Committee

APPENDIX 1 MEMBERS OF THE STUDY AND COMMITTEES

CKV Study Team

Technical Working Group (Total 18 members) *As of March 12, 2007*

Organizations	Name	Designation / Organizational Position
MOLD	Mr. Babu Ram Gautam	Under Secretary
SWMRMC	Mr. Guna Raj Ghimire (Chairperson)	General Manager
	Mr. Ashok Shahi	Civil Engineer
	Mr. Ram Sharan Maharjan	Civil Engineer
KMC	Mr. Rabin Man Shrestha	Head, Environment Department
	Mr. Deepak Ratna Kansakar	Engineer, Solid Waste Management Section
	Mr. Purusotam Shakya	Chief, Mechanical Section
LSMC	Mr. Rudra Prasad Gautam	Chief, Public Works Division
	Mr. Pradeep Amatya	Chief, Environment and Sanitation Section
	Ms. Sabina Maharjan	Staff, Community Development Section
BKM	Mr. Laxman Kisiju	Chief, Physical Planning and Works Section
	Mr. Moti Bhakta Shrestha	Chief, Social Welfare Section
	Mr. Dinesh Rajbhandari	Sanitation Engineer, Physical Planning and Works Section
MTM	Mr. Satya Narayan Shah	Chief, Planning and Technical Section
	Ms. Krishna Kumari Shrestha	Assistant, Community Development and Sanitation Section
	Mr. Keshav Silwal	Legal Officer
	Mr. Surendra Shrestha	Junior Engineer, Planning and Technical Section
KRM	Mr. Anuj Pradhan	Chief, Solid Waste Management Unit
	Mr. Gyan Bazra Maharjan	Assistant, Solid Waste Management Unit/Accounting

Task Force (Total 52 members) *As of March 12, 2007*

Organizations	Name	Designation / Organizational Position
SWMRMC (8)	Mr. Surya Man Shakya	Act. Dean of SchEMS (Former General Manager)
	Mr. Guna Raj Ghimire	General Manager
	Mr. Ashok Shahi	Civil Engineer
	Mr. Ram Sharan Maharajan	Civil Engineer
	Mr. Lal Bahadur Karki	Account Officer
	Mr. Topa Ram Acharya	Administration Officer
	Mr. Ashok Ratna Tuladhar	Consultant Engineer
	Dr. Nawa Raj Khatiwada	Environmental Engineer, SchEMS
KMC (13)	Mr. Rabin Man Shrestha	Head, Environment Department
	Mr. Purusotam Shakya	Chief, Mechanical Section
	Ms. Shriju Pradhan	Community Mobilization Unit
	Ms. Sanu Maiya Maharjan	Community Mobilization Unit
	Mr. Deepak Ratna Kansakar	Engineer, Solid Waste Management Section
	Mr. Krishna P. Kafle	Department of Mines and Geology
	Mr. Puskar L. Shrestha	LIUD (NGO)
	Mr. Basu Upreti	Kathmandu Mahanagar SWM Services
	Mr. Padma S. Joshi	IOE/TU
	Mr. Shirish Singh	ENPHO (NGO)
	Mr. Prakash M. Sharma	PROPUBLIC (NGO)
	Mr. Drona Raj Ghimire	Nefeej
	Mr. Shankar Raj Kandel	Head, International Cooperation and Coordination Department
LSMC (8)	Mr. Prem Raj Joshi	CEO
	Mr. Rudra Prasad Gautam	Chief, Public Works Division
	Mr. Pradeep Amatya	Chief, Environment and Sanitation Section

Organizations	Name	Designation / Organizational Position
	Mr. Prabin Shrestha	Chief, Town Development Division
	Mr. Mukunda Ranjit	Overseer, Environment Section
	Mr. Ashok Shrestha	Division Chief, Administrative Division
	Ms. Laxmi Prasad Rajbhandari	Chief, Community Development Section
	Ms. Sabina Maharjan	Staff, Community Development Section
BKM (9)	Mr. Indra P. Karki	CEO
	Mr. Laxman Kisiju	Chief, Planning and Technical Section
	Mr. Moti Bhakta Shrestha	Chief, Social Welfare & Sanitation Section
	Mr. Dinesh Rajbhandari	Sanitation Engineer, Planning and Technical Section
	Mr. Dilip Kumar Suwal	Chief, Sanitation Sub-section
	Mr. Krishna Prashad Suwal	Assistant, Social Welfare & Sanitation Section
	Mr. Revid Kusma	Chief, Store Sub-section
	Ms. Ambika Dhauvadel	Chief, Administration Section
	Ms. Ratnamaya Shrestha	Chief, Financial Section
MTM (8)	Mr. Satya Narayan Shah	Chief, Planning and Technical Section
	Ms. Krishna Kumari Shrestha	Assistant, Community Development and Sanitation Section
	Mr. Tulsi Bhakta Tako	Section Chief, Community Development and Sanitation Section
	Mr. Surendra Shrestha	Junior Engineer, Planning and Technical Section
	Mr. Shiva Man Shrestha	Policy Management / Lawyer
	Mr. Kai Prashad Waije	Architect/ Urban Planner
	Ms. Shanti Karanjit	Environmentalist
	Mr. Krishna Sundar Thapamagar	Sub Accountant, Account Section
KRM (6)	Mr. Bal Krishna Maharajan	Chief, Planning and Technical Section
	Mr. Anuj Pradhan	Assistant, Planning and Technical Section
	Mr. Gyan Bazra Maharjan	Assistant, Solid Waste Management/Accounting
	Mr. Krishna Bhola Maharjan	Junior Engineer, Planning and Technical Section
	Mr. Sanu Babu Pariyar	Account Officer, Administration Section
	Mr. Swodesh Maharjan	Unique Group (NGO)

JICA Study Team (Total 12 members) *As of March 12, 2007*

Name	Assignment
Mr. Toshiyuki Ujiie	Team Leader/ Solid Waste Management Policy/ Environmental and Social Considerations
Mr. Shungo Soeda	Deputy Team Leader/ Collection and Transportation/ Recycling System Analysis
Mr. Mahmoud Riad	Waste Management Facility Plan and Operation
Mr. Shigeru Kawanabe/ Mr. Kenichi Yokota	Waste Management Facility Plan and Operation (2)
Mr. Masahiro Saito	Landfill Design
Mr. Kiyoshi Shimizu	Waste Minimization Facility Plan and Design
Mr. Hideo Tsuta	Environmental and Social Considerations (River Engineering/Hydrology)
Mr. Yasuishi Momose	Environmental and Social Considerations (Geology/ Disaster Prevention)
Mr. Satoshi Higashinakagawa	Environmental and Social Considerations (Field Workshop)
Ms. Minako Nakatani	Organization and Institution /Human Resources Development
Mr. Noboru Osakabe	Financial Analysis
Mr. Takahiro Kamishita	Coordinator / Public Relations

Committee

Steering Committee Members *As of March 12, 2007*

Organizations	Name	Position
MOLD (as chairperson)	Mr. Som Lal Subedi	Joint Secretary
MOLD, Environmental Management Section of Municipal Management Division (as member secretary)	Mr. Babu Ram Gautam	Under Secretary, Chief of Environmental Management Section
SWMRMC	Mr. Guna Raj Ghimire	General Manager
KMC	Mr. Dinesh Kumar Thapalia	CEO
LSMC	Mr. Prem Raj Joshi	CEO
BKM	Mr. Indra Prasad Karki	CEO
MTM	Mr. Bishnu Dutta Gautam	CEO
KRM	Mr. Sarjo Guragain	CEO
Ministry of Environment, Science and Technology	Ms. Meera Joshi	Civil Engineer/EIA Expert, Environmental Assessment Section, Environment Division
Ministry of Physical Planning and Works	Mr. Hari Ram Koirala	Joint Secretary
Ministry of Industry, Commerce and Supplies	Mr. Baikuntha Bd. Adhikari	Department of Industry, Director
Ministry of Education and Sports	Mr. Narayan Pd. Kafle	Under Secretary
Ministry of Agriculture and Cooperative	Ms. Bidya Panndey	Horticulture Development Officer
Ministry of Health and Population	Dr. Bishnu Prasad Pandit	Chief Specialist, Curative Division

APPENDIX 2

Technology Transfer Seminar

APPENDIX 2 TECHNOLOGY TRANSFER SEMIMAR

1 Proceedings of 5th Seminar

Date: August 2 and 3, 2006
Time: 9:30 - 16:50 (1st day), 9:00-12:50 (2nd day)
Venue: Hotel Malla
Participants: Total 149 people (MOLD, SWMRMC, Other ministries, Five municipalities, Donors, NGOs, Private sectors, Academics, Media, EOJ, JICA)
Distribution
- Handout of each presentation material
- Newsletter (No.7)
- CKV file and memo pad made of recycled paper
- CKV ball pen

2 Agenda

1st Day (2nd August, 2006)

Time	Program	Presenters
9:00- 9:30	Registration	
9:30- 9:35	Welcome Address	JICA Nepal
9:35- 9:45	Speech by Chairperson	MOLD
9:45- 9:55	Introduction of the CVK Study	SWMRMC
9:55-10:10	Follow-up and Monitoring Phase of the CKV Study	JICA Study Team
10:10-10:20	Closing Remarks of Opening Session (Speech by Chief Guest)	MOLD
10:20-10:40	Coffee Break	
10:40-10:55	Presentation 1: Present Community-Based Activities of Recycling and Composting	KMC
10:55-11:10	Presentation 2: Present Community-Based Activities of Plastic Separation	KRM
11:10-11:30	Presentation 3: Introduction of CoMoN (Community Mobilization Network)	CoMoN member (LSMC)
11:30-12:00	Question and Answer	
12:00-13:00	Lunch	
13:00-13:50	Keynote Speech 1: Introduction of Experiences for Community Mobilization for Recycling and SWM in Bangladesh and Other Countries.	Prof. Miyake Univ. of Kitakyushu
13:50-14:20	Question and Answer	
14:20-14:40	Presentation 4: Activities at Sisdol Short-term Landfill and Lessons Learns from the Operation and Secondary Transportation	KMC/LSMC
14:40-15:00	Presentation 5: EIA Study for Banchare Danda Long-term Landfill in Okharpauwa	SWMRMC
15:00-15:20	Coffee Break	
15:50-16:20	Question and Answer	
16:20-16:30	Closing Remarks	MOLD
16:30-16:50	Introduction of 2nd Day	JICA Study Team

2nd Day (3rd August, 2006)

Time	Program	Presenters
8:30-9:00	Registration	
9:00-9:30	Keynote Speech 2: Suggestions to Sanitary Landfill Management	Dr. Tanaka, Fukuoka Univ.
9:30-10:00	Question and Answer	
10:00-10:20	Coffee Break	
10:20-12:20	Panel Discussion: Capacity Development for SWM (Five municipalities, SWMRMC, JICA Study Team and JICA)	JICA Study Team (Facilitation)
12:20-12:30	Vote of Thanks	SWMRMC
12:30-12:40	Closing Speech by Guests	JICA (Tokyo)
12:40-12:50	Closing Remarks	MOLD
12:50-	Lunch and Good by	

3 Records of the 5th Seminar (1st Day)

3.1 Welcome Address

Resident representative of JICA Nepal Office greeted for the participants as welcome address and express his gratitude towards relevant organization for success of the Study.

3.2 Introduction of the Study

Following welcome address, the general manager of SWMRMC introduced the Study shortly including Action Plan developed by each municipality and SWMRMC, and a series of Pilot Projects implemented. After that, the JICA Study Team explained overall work flow of the monitoring and follow-up activities of the Study.

3.3 Presentations of Follow-up and Monitoring Phase Activities

Total eight Focal Points presented their activities which had been carried out continuously from the Phase 3 of the Study or newly initiated activities in 10-15 minutes by using slides utilizing several photos and/or moving record. Almost all Focal Points tried to explain in English through many times exercises previously.

3.4 Key Note Speech by Prof. Miyake, University of Kitakyushu

Prof. Miyake explained community-based solid waste management which he had been involved in Dhaka, Indonesia and Japan. He also stressed importance to focus on sweepers and waste pickers for better solid waste management. Effectiveness of environmental education was also explained including training course of the JICA Country Focused Training on SWM.

3.5 Discussion Session

During the discussion session of the 1st Day, a variety of questions and opinions especially for community-base activities, Sisdol Short-term Landfill Site and Prof. Miyake presentation on the Introduction of Experiences for Community Mobilization for Recycling and SWM in

Bangladesh and Other Countries were exchanged among the participants, presenters and the CKV Study Team.

4 Records of the 5th Seminar (2nd Day)

4.1 Key Note Speech by Dr.Tanaka, Fukuoka University

Dr.Tanaka explained the leachate treatment methodologies which have been used in the semi-aerobic landfill system at various countries such as Japan, Malaysia, Iran, and Samoa. She also introduced leachate treatment methods using charcoal filters and coral reef including recirculation system.

4.2 Panel Discussion on Capacity Development for SWM

Following brief explanation of the result of monitoring and follow-up as well as basic concept of capacity development of JICA by the JICA Study Team, the panel discussion on capacity development for SWM which was the last agenda of 5th seminar was held with a facilitator of the JICA Study Team. Total 10 panelists participated from MOLD, SWMRMC, five municipalities, JICA Study Team and Prof. Miyake. At the beginning, each municipality presented lessons learned through the annual action plan implementation and the whole study period.

4.3 Discussion Session

During the discussion session of 2nd Day, questions for the presentation of Dr. Tanaka and the capacity development for SWM were raised and answered.

4.4 Closing

At the closing ceremony, Mr. Shiro AMANO, a leader of JICA Monitoring Mission, adressed a speech and expressed a great impression of Nepalese efforts and a various kinds of activities under the Study. He also spoke the expectation their continuous efforts on SWM for future in order to achieve their vision.

APPENDIX 3

Selected Photos

APPENDIX 3 SELECTED PHOTOS

5th Steering Committee
(December 13, 2005)

6th Steering Committee
(March 17, 2006)

TWG Meeting
(November, 2005)

TWG Meeting on Banchare Danda LFS
(June, 2006)

AWP Monitoring Session
(November, 2005)

AWP Monitoring Session
(February, 2006)

Meetings and Workshops

Source Separated Collection in BKM
(December, 2005)

Recycling Center in Ward No 21 in KMC
(January, 2006)

Plastic Separation Collection in LSMC
(November, 2005)

Plastic Separation Collection in KRM
(January, 2006)

Workshop for SW Data Management
(March 2006)

Workshop for SW Data Management
(March 2006)

Follow-up for Action Plan Implementation

Follow-up Survey at Banchare Danda
(January, 2006)

Follow-up Survey at Banchare Danda
(February, 2006)

Follow-up Survey at Banchare Danda
(February, 2006)

Follow-up Survey at Banchare Danda
(February, 2006)

Planned Balaju Transfer Station Site
(February, 2006)

Planned Afadole Transfer Station Site
(February, 2006)

Follow-up for Environmental and Social Considerations for Facility Development

Landfilling Activities at Sisdol Landfill (November, 2005)

Operation of Aeration System at Leachate Retention Pond (November, 2005)

Water Quality Monitoring at Leachate Retention Pond (January, 2006)

Condition of Sisdol Landfill (March, 2006)

Condition of Sisdol Landfill (September, 2006)

Condition of Sisdol Landfill (March, 2007)

Follow-up for Operation of Sisdol Short-term Landfill Site (1/2)

1st Training for Improvement of Landfill Operation (September, 2006)

1st Training for Improvement of Landfill Operation (September, 2006)

2nd Training for Improvement of Landfill Operation (December, 2006)

2nd Training for Improvement of Landfill Operation (December, 2006)

3rd Training for Improvement of Landfill Operation (March, 2007)

3rd Training for Improvement of Landfill Operation (March, 2007)

Follow-up for Operation of Sisdol Short-term Landfill Site (2/2)

Ceremony of Handing Over of Transportation Vehicles at Teku T/S (December, 2006)

Loading and Unloading Practices in LSMC (March, 2006)

Follow-up for Operation of Teku Transfer Station (Secondary Transportation)

Country Focused Training (December, 2005)

Fukuoka Method Workshop (December, 2005)

International Conference on SWM (January, 2006)

Technology Transfer Seminar (August 2-3, 2006)

Other Relating Activities